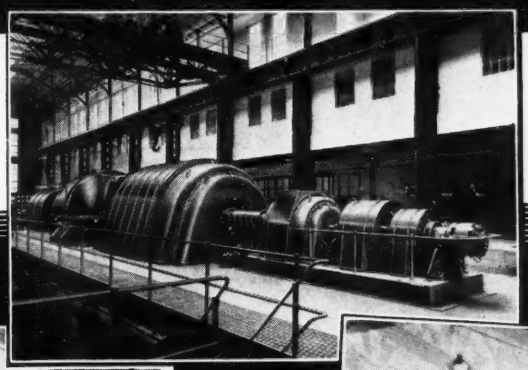
ELECTRICAL REVIEW

FOUNDED 1872

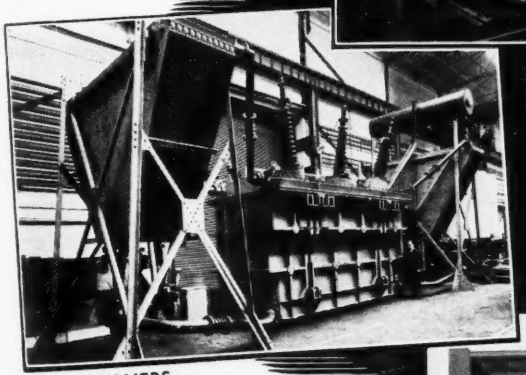
Vol. CXXVIII. No. 3297 JANUARY 31, 1941 SIXPENCE

FEB 28 1941

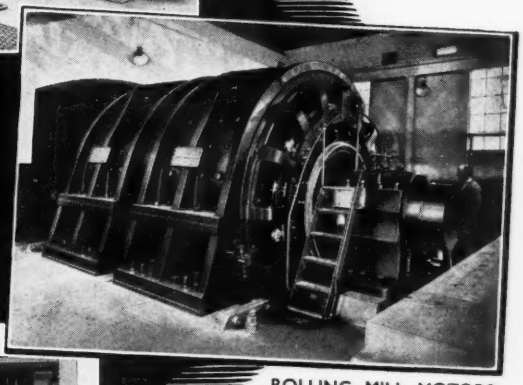
G.E.C.
ELECTRICAL PLANT



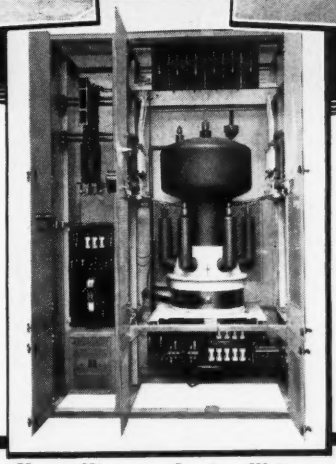
TURBO PLANT



TRANSFORMERS



ROLLING MILL MOTORS



MERCURY ARC RECTIFIERS

SERVING INDUSTRY'S VITAL NEEDS IN WAR AS IN PEACE

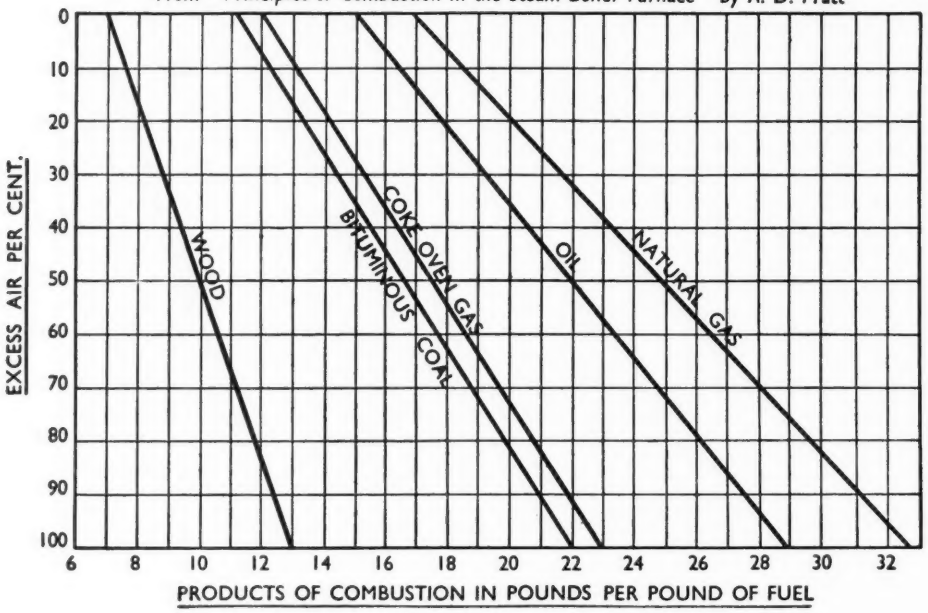
The G.E.C. manufactures every type of electrical power plant and control gear, including the largest units needed in modern service.

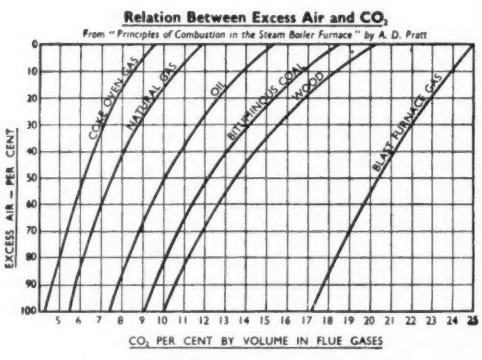
Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2

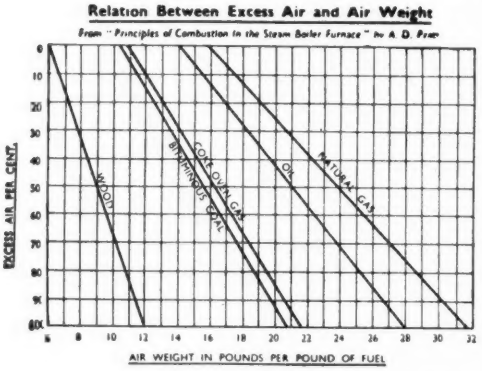
What does CO_2 mean?

Relation Between Excess Air and Products of Combustion

From "Principles of Combustion in the Steam Boiler Furnace" by A. D. Pratt




Relation Between Excess Air and CO_2
From "Principles of Combustion in the Steam Boiler Furnace" by A. D. Pratt
EXCESS AIR – PER CENT
COKE OVEN GAS
NATURAL GAS
OIL
BITUMINOUS COAL
WOOD
BLAST FURNACE GAS
CO_2 PER CENT BY VOLUME IN FLUE GASES


Relation Between Excess Air and Air Weight
From "Principles of Combustion in the Steam Boiler Furnace" by A. D. Pratt
EXCESS AIR PER CENT.
WOOD
BITUMINOUS COAL
COKE OVEN GAS
OIL
NATURAL GAS
AIR WEIGHT IN POUNDS PER POUND OF FUEL

FROM the above chart it will be seen that when burning 1 lb. of coal, an increase from 20% to 100% excess air means that the weight of the products of combustion is increased by approximately 8½ lb.

Our previous advertisement showed that this increase in excess air involved an increase in the weight of air for combustion by the same amount. Thus the forced draught and the induced draught fans together must handle approximately 17 lb. more air and products of combustion than that necessary for efficient combustion.

In the case of a boiler for 175,000 lb. of steam per hour, with 20% excess air the fan motors would be rated at 196 h.p., which would be increased at 100% excess air to 875 h.p. thus involving an increase in electrical input to the motor terminals of 570 KW. Assuming 20 hours per day and 300 days per year, at ½d. per KWH this unnecessary expenditure in fan power amounts to £7,130 per annum, which in itself is more than sufficient to pay for a Bailey furnace. This sum capitalised at 4% interest for 20 years amounts to over £212,000. Bailey furnace construction permits operation with minimum excess air over a very wide range of load, so that the saving in fan power debit alone gives a very handsome return on capital invested.

Criticism might be made that the limits are too wide in the foregoing example, but even if operation is assumed with 60% excess air, then the unnecessary fan power expenditure is £2,840 per annum, which when capitalised amounts to £84,570. However, when it is realised that this fan power debit is one of the smallest items entering into the balance sheet, it will be obvious that Bailey furnace construction is in the last analysis the cheapest construction which can be installed.

(For convenience we reproduce the charts from our Nos. 1 and 2 advertisements in this series, showing the relationship between excess air and CO_2 and weight of air for combustion.)

This is the third of a series of three advertisements

BABCOCK & WILCOX LTD. BABCOCK HOUSE, FARRINGDON ST. LONDON, E.C.4.

THE ELECTRICAL REVIEW

Volume CXXVIII — No. 3297

Friday, January 31st, 1941

Contents

	Page
Editorial—Power for Industry	295
Industrial Heating	297
The Electric Motor	301
Industrial Switchgear. By J. M. Goodall, M.I.E.E.	304
Switchgear for War Use	306
Distribution Gear	308
Personal	310
Power Engineers' Salaries	311
Electrical Research	312
Control Equipment	313
Direct Current. By D. B. Hoseason, M.I.E.E.	315
Machine Tools	317
Correspondence	320
Electric Welding	321
Electro-plating	324
Commercial and Industrial	325
Electricity Supply	327
Financial Section	329
Contract Information	332

Classified Advertisements (Official Notices, Situations Vacant, etc.)	55
Index to Advertisers	86

EDITORIAL, ADVERTISING AND PUBLISHING OFFICES: Dorset House, Stamford Street, London, S.E.1

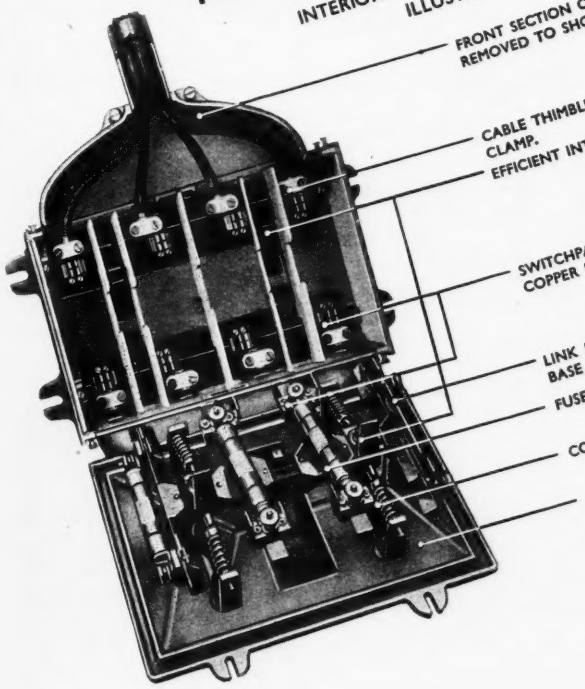
Telegraphic Address: "Ageekay, Sedist, London." Code: A B C. Telephone No.: Waterloo 3333 (35 lines)

Subscription Rates, Postage free: United Kingdom, £1 16s. 10d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum

Cheques and Postal Orders (on Chief Office, London) to be made payable to ELECTRICAL REVIEW LTD., and crossed "Lloyds Bank"

BERRY'S "VIKING" FUSE-SWITCH

INTERIOR VIEW ILLUSTRATING

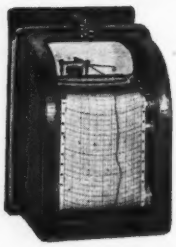

FRONT SECTION OF SPLIT END CASTING REMOVED TO SHOW EASY WIRING FEATURE.
CABLE THIMBLES SECURED IN EASILY REMOVABLE CLAMP.
EFFICIENT INTERLOCK.
SWITCHPARTS OF HIGH CONDUCTIVITY COPPER LIBERALLY RATED.
LINK FOR NEUTRAL (OR CAN BE FITTED ACROSS BASE CONTACTS).
FUSES QUICKLY REPLACED.
COMPRESSION SPRINGS GIVING EASY ACTION.

SWITCHGEAR AND SWITCHBOARDS FOR MUNITION WORKS AIRCRAFT FACTORIES AND INDUSTRIAL POWER DISTRIBUTION SCHEMES.

Berry's ELECTRIC LTD.

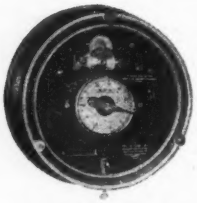
TOUCHBUTTON HOUSE, NEWMAN STREET
LONDON, W.1
Telephone: Museum 6800 (9 lines)
also at
Birmingham, Manchester and Newcastle

OTHER EVERETT EDGCUMBE PRODUCTS INCLUDE–



"INKWELL" GRAPHERS

To record Amperes—Volts—Watts—Power Factor—Frequency—Speed.



MAXIMUM DEMAND TELL-TALE

For consumers on maximum demand two-part tariff, enables standing charge to be kept at the lowest level.

SYNCLOCK TIME INTERVAL METERS

are invaluable for testing the time settings of Relays, Circuit Breakers and Integrating Meters, or other electrical apparatus in the operation of which time is an important feature.

● **PRECISION MODEL.** An instrument of extreme sensitiveness which permits the shortest time intervals to be measured with an accuracy of 1/100th of a second.

● **INDUSTRIAL MODEL.** For measuring time intervals from 1/5th of a second up to 5 minutes with an accuracy of 1/20th of a second.

MAKERS OF ALL KINDS OF INDICATING & RECORDING ELECTRICAL MEASURING INSTRUMENTS

EVERETT EDGCUMBE

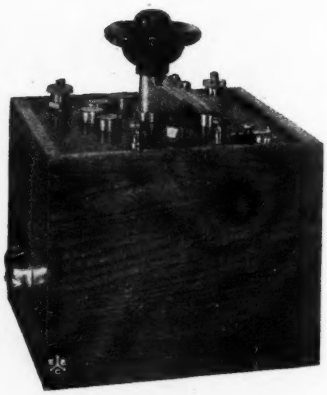
COLINDALE WORKS, LONDON, N.W.9

LOW RANGE PHOTO-METER
(for A.R.P. Lighting)

Measurement of illumination as low as 0.0002 foot-candle, surface brightness and candle-power.

PORTABLE TRANSFORMERS

for laboratory use, meter and general testing. Self-contained up to 500 amperes, with selector switch for certain ranges.



EVERETT EDGCUMBE PRECISION CURRENT TRANSFORMERS with associated instruments have long been employed by the N.P.L. and other standardising authorities throughout the world.

THE
ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXVIII. No. 3297 JANUARY 31, 1941 Price SIXPENCE

Power for Industry

How Electricity is Serving the Nation

HOW greatly the success of the country's war effort depends upon electricity is aptly illustrated in the present activity of British manufacturers of electrical plant and appliances. Excluding what is being done in the way of direct assistance to the armed forces and taking account of production of a more normal kind (which indirectly serves the same end), output is being well maintained and in some sections has reached record dimensions. Accompanying these achievements there has been intensified research, largely in the direction of finding substitutes for some materials and economising in others.

From the varied information sent us by leading manufacturing concerns relating to the vast range of electrical developments that have been put in hand or completed during recent months, we were able to mention last week a few, but only a few, that are representative of general tendencies. Articles in this issue provide abundant evidence that the resources of our workshops are capable of meeting all demands for equipment of a more standardised kind which is necessary in view of the nation's urgent demands.

Large Generating Sets

While in present conditions many details may not be given, enough can be said to show that technical advance continues. Thus, in the case of generation, steam temperatures of 900 deg. F. at the turbine stop valve are to be associated with pressures as low as 650 lb. per sq. in.; more units of up to 50,000 kW rating are under construction to run at 3,000 RPM; 33 kV alternators are being ordered in increasing numbers.

Successful attempts made during the past year to protect transformers against surges should enhance their already high reputation for reliability. From experience with conversion to DC by means of rectifiers, it appears that any fears as to the ability of the glass-bulb type to stand up to the effects of blast are groundless. Perhaps the most important of the progressive improvements introduced in the design of switchgear are those that facilitate maintenance, but developments in oil-poor circuit breakers for the higher voltages and air-breakers for medium voltage represent a trend of importance in their implications for the future. The growing demand for high-rupturing-capacity fuses illustrates another tendency.

Rapid works extensions have entailed the manufacture on a very large scale of motors of all sizes and of their associated control gear. As might be expected electric welding is finding ever-increasing forms of application. The value of local power-factor correction appears to be more widely appreciated among industrial users as a result of heavier loads carried by works distributors and of the need, sometimes, to use motors in stock for lighter duties than their ratings.

Solving Control Problems

Some topical significance is to be attached to the orders for trolley buses from all parts of the country. While steel works provide, probably, the most spectacular instances of electrification in large power drives and in industrial heating, it is clear that the solution of control problems has provided just as much scope for engineering ability. Another point that should be noted is the stimulus given to production by the higher standards of lighting that are being adopted in munition factories.

A large proportion of the orders is for export. That is gratifying on two grounds. It means that the electrical industry is doing its share towards paying for the import of vital necessities. It also gives proof of the confidence felt in other countries that Britain can deliver the goods of the same quality as before.

Our choice of examples for illustrating the contribution made by electricity to national defence has been influenced by a further consideration. That consideration is the lack of appreciation—more than a little disturbing in present circumstances—sometimes shown by officials of Government Departments concerning the nature and value of the services rendered by electricity supply undertakings. Some of them, apparently, hold the forty-years-out-of-date view that

the chief function of our generating stations is merely to supply current for the lighting of houses and shops. Actually in existing conditions we doubt whether this accounts for a tenth of the output. Apart from the not inconsiderable public duty of enabling workers and their families to have properly cooked food and to warm their homes (which accounts for about one-fifth of the balance) there remains the fact that much more than half the electricity generated is required to keep the factories running. But for the tremendous war effort of the electrical industry, the courage and skill of our fighting forces would be of little avail and it is of the first importance that those holding positions of executive responsibility in national affairs should realise this to the full.

Widening Outlook

AN intimate knowledge of a few aspects only of electrical engineering can be obtained in practice. It is, nevertheless, essential that those who wish to do effective work should be kept informed of what is being done in other and kindred spheres. The presentation of full details of these may be to many not only a waste of paper but also repellant. Moreover, as the President of the I.E.E., Mr. J. R. Beard, points out in his foreword to the new form of the *Journal* for January, even the approach to one's own subject is more difficult when cumbered with a forbidding bulk of highly technical extraneous matter. An important principle in the dissemination of scientific knowledge, is embodied in Part 1 which contains, in addition to items of interest to members as a whole, abstracts of papers that are printed in full in Parts 2 and 3. These abstracts are designed to bring out the main features of the originals for the benefit of members without the requisite special knowledge. At the same time, their nature and scope is sufficient to indicate to the specialist whether he should study the whole paper. The scheme seems to be flexible enough to permit of modification or extension as experience may show to be desirable.

I.E.E. Sections

WHILE membership of the special sections of the Institution of Electrical Engineers is growing steadily, progress has not been so rapid as was generally expected when the sections were formed. Out of a total membership of over 20,000, the number enrolled in the Wireless Section is stated by its chairman, Mr. W. J. Picken, to be 1,133. This probably indicates a better realisation of opportunities than does the 1,692 of the Transmission Section, which represents only a small proportion of all those concerned in the design, construction, maintenance and operation of power cables and overhead lines. It may be, as Mr. H. J. Allcock, this year's chairman, suggests, that I.E.E. members believe the possession of the requisite qualifications to confer on them automatically membership of their appropriate sections. This is not so. It is a test of the interest of members in the affairs of a section that they shall take the small trouble entailed in applying for inclusion.

Wiring Rules

EVERYBODY who has tried it knows how difficult it is to draw up regulations which admit of only one construction and at the same time avoid the loopholes which the unscrupulous invariably seek. The endeavour to meet these requirements has exposed the I.E.E. Wiring Regulations to criticism and has even led to the publication of a simplified version by the A.S.E.E. In fairness it must be said that the latest edition shows great improvement. All this, however, is merely a preliminary to showing that things are much the same in Australia. The *Electrical and Radio Trader* in welcoming (if that is the right word) the new edition of the wiring rules issued by the Standards Association of Australia says :—" We sympathise with the contractor who is required to quote on a job without knowing just what the electrical inspector is going to require or how he is going to interpret the rules." After quoting an opinion that there has been no real consideration of the expense involved by some of the requirements, it says : " The draughtsmen of the rules seem to have been kindred to a Dutch lawyer. They have camouflaged the real meaning with many words so that any interpretation desired can be read into them." Perhaps the I.E.E. Regulations are not so bad after all.

Aiding Reconstruction

RECOVERY after the Napoleonic wars was much more rapid than was expected chiefly because of the development of the steam engine, as Lord Falmouth said recently in his presidential address to the Junior Institution of Engineers, when he pointed out that a similar service was performed after 1918 through increasing the capacity and efficiency of the steam turbine. His tentative suggestion that an improved form of internal-combustion engine may give the answer to the question of what will be the *deus ex machina* after this war does not appear to us to be well founded. Reliable and efficient as this prime-mover is, it is handicapped by its low power-weight and power-space ratios in the large capacities that would be required for generating electricity on the scale of the future. It seems a retrograde step, too, to reintroduce pistons and cranks. On these grounds his reference to the potentialities of the internal-combustion turbine is probably more apt. Blade temperatures at present possible limit its thermal efficiency and output and prevent its competing with the steam turbine, the largest rated gas turbo-alternator yet built being the 4,000-kW unit recently installed at Neuchâtel in a bomb-proof station for maintaining essential supplies. In any event the greatest prosperity of the greatest number will depend upon the provision of an increased HP per worker at a low cost, and it is the social duty of engineers to consider how this can be done.

Morley's Wise Decision

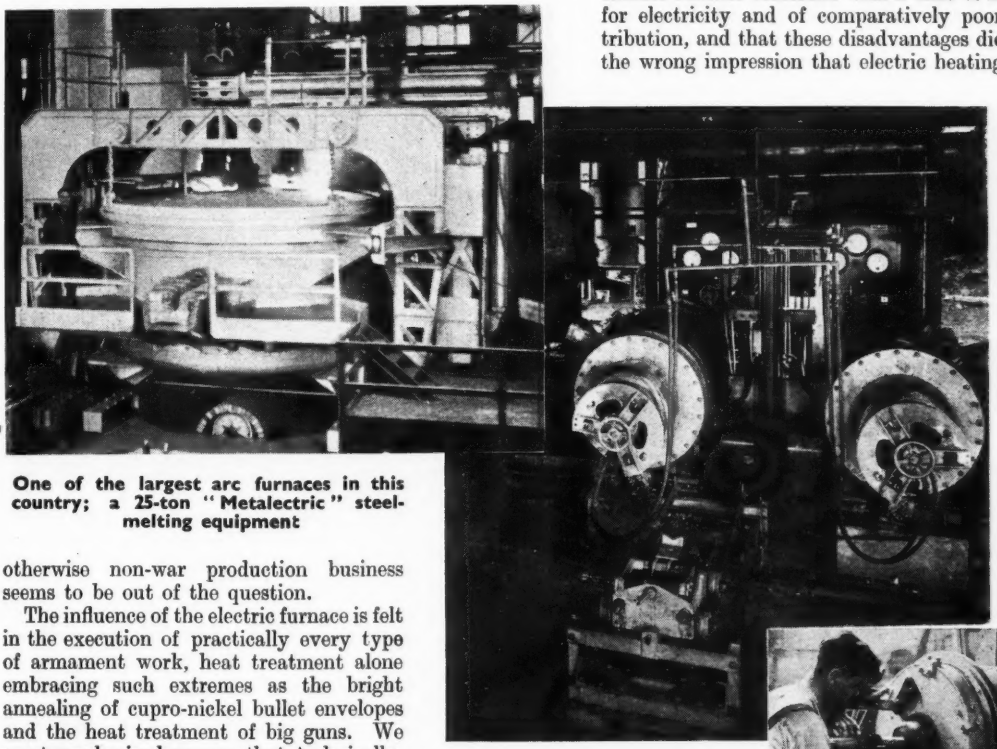
THE decision of the Morley Electricity Committee to continue the electricity showroom service is to be commended. The restriction in the supply of domestic electrical appliances and the consequent falling off in the provision of these appliances under hire-purchase schemes may reduce the turnover of the showrooms, but as Mr. N. Hunter, the borough electrical engineer points out, the true value of showrooms is not measured in terms of hard cash but by the value of the service which they are able to render to consumers and the public generally. It is important that electricity supply authorities should maintain contact with the public and the service given now by electricity showrooms will be amply repaid when better times return.

Industrial Heating

War Influence on Development

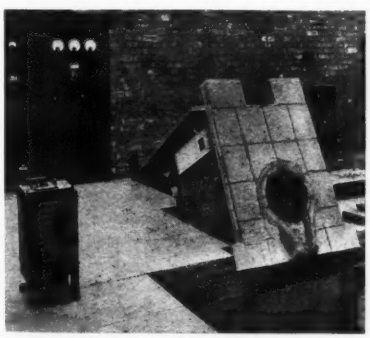
A review of electric furnace developments, with special reference to the tremendous speed-up caused by the war

WE do not know of another section of the electrical manufacturing field which is making a greater effort towards winning the war than the electric furnace section. At the present moment its production is practically wholly devoted to war purposes and is made up of large contracts for the defence services and indirect war-effort supplies to private firms mainly for research work. There are export trade possibilities, but otherwise non-war production business seems to be out of the question.



One of the largest arc furnaces in this country; a 25-ton "Metalectric" steel-melting equipment

The influence of the electric furnace is felt in the execution of practically every type of armament work, heat treatment alone embracing such extremes as the bright annealing of cupro-nickel bullet envelopes and the heat treatment of big guns. We must emphasise however, that, technically, the electric furnace was ready when the war started, and the first gun-pit furnace was installed in this country some years before that. But it is not the furnace specially designed for armament production which is most in demand; the greater part of the orders of to-day are for standard designs developed for normal peace-time industrial production. That standard equipment is accepted so freely for the war machine is highly creditable, and we hope that in the better days to come those special furnaces which are being developed as the result of new applications due entirely to the war will find a place in normal industry.

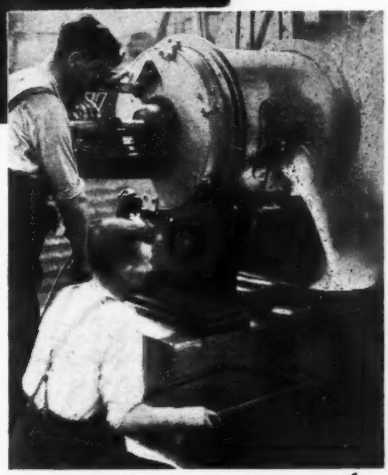


The h.f. furnace produces the highest grades of steel alloys; a 10-cwt. "Efco" unit

It is pleasing to learn that inquiries indicate that as soon as present exigencies permit export business can be obtained. So far as we can judge such inquiries are largely for pottery work, with high-speed steel heat treatment as a close second.

It was unfortunate that the development period of the electric furnace coincided with a time of high supply costs for electricity and of comparatively poor electricity distribution, and that these disadvantages did much to create the wrong impression that electric heating was expensive. In some quarters this opinion is still held, but it is now more due to the old error of making direct comparisons between electricity and fuel costs without taking into sideration the relative thermal efficiencies of the equipments.

What furnace is there using a heating medium other than electricity for which a thermal efficiency as high as 75 to 85 per cent. can be claimed? The following facts are indisputable and explain the efforts of fuel furnace manufacturers to copy electric furnace design, of which the radiant tube gas furnace, with alloy tubes inside which the gas is burnt, is an outstanding example. There is no other heating medium so certain and economical in operation as electricity; electricity gives a greater uniformity of heat



Rocking furnaces are particularly suitable for producing specially high grades of cast-iron; a "Birlec" rocking arc furnace

'Efco' rocking resistor furnaces

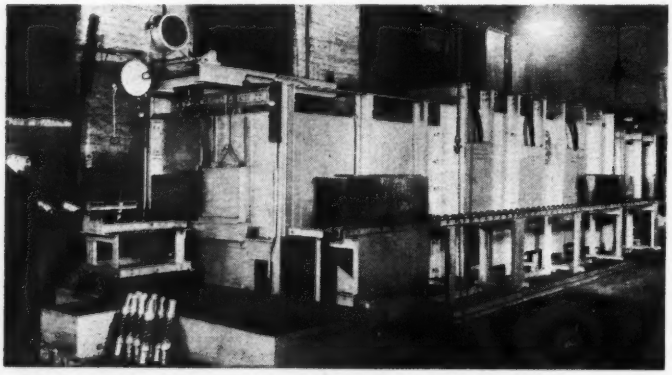
distribution than any other medium; the electric furnace operates in conditions helpful to production which cannot be achieved so cheaply, and often not at all, in other types of furnace; the electric furnace offers the cleanest form of heat treatment; the advantages of the electric furnace lie in the unrivalled degree of precision control and flexibility obtainable.

It is not appreciated so widely as it should be in the electrical industry how far electric heating has been solely responsible for certain major industrial developments. Certain of our highest grades of alloy steels could not have been produced but for the arc and, in particular, the high-frequency induction furnaces. The really bright annealing demanded for cold rolled steel strip is essentially an electrical process. The absolute precision control demanded for heat treatment in the light-metal industry so as to avoid the upsetting of grain structures would be quite impossible with any other heating medium.

The Melting Trend

When we think for a moment of such vitally important and delicate developments, how clear becomes the necessity to disabuse our mind of the old idea of the electric furnace as a box fitted with elements. Such a picture is now absurd, and the only outlook which will secure to industry the full benefits of industrial electric heating is one that visualises the electric furnace as a precision machine tool, for indeed that is what it is. To assist in detailed consideration of electric furnaces we regard them first in the light of three industrial processes—melting; preheating for rolling, forging, extruding, etc.; and heat treatment for the attainment of certain physical properties. For melting the arc and high- and low-frequency induction furnaces are mainly used, while the resistance furnace satisfies most demands for preheating and heat treatment, but there are certain minor cases of overlapping between these classifications.

In view of the very considerable American influence on electric steel melting developments in this country a word on the general practice across the Atlantic will not be out of place as an opening note to this section. Electric melting is much more widely adopted in the United States than here, but the reason for this is not, as is generally supposed in connection with many electrical developments, that electricity is cheaper—often it is dearer. The main reasons are that the American manufacturer will usually more readily spend money on plant replacements; that labour costs are considerably higher; and that mass production, which is, of course, much more widely practised in America, depends for its success upon rigid uniformity of the raw materials. A surprising thing about the American steel industry is that the converter has almost entirely disappeared from the foundry. The electric furnace is now used widely for light and medium castings, heavy work alone being left to the open-hearth furnaces. Support is being given to this idea in this country, too, and many steel manufacturers at home now assert that the electric furnace is cheaper to operate than the converter.



Almost every heat-treatment process can be carried out beneficially in a protective atmosphere; a "Birlec" controlled-atmosphere furnace

Since we last reviewed electric furnace developments in this country there seems to have been a period of consolidation with regard to the respective fields of arc and high-frequency furnaces, and it is now possible to define more closely the uses of each. Perhaps it will be as well first to remove any impression that the high-frequency furnace is used for refining, for such work is left to the basic-lined arc equipment in which the charge is melted and slagged to remove such impurities as sulphur and phosphorus. Consequently the principal charges for the arc furnace are pig iron and scrap, and the products are mainly commercial grades of steel. On the other hand the h.f. furnace is particularly suitable for straight melts of known composition which do not result in the radically altered compositions expected from the arc furnace. To regard the h.f. furnace from another aspect we may say that it is used where rigid control is required over the chemical composition of the charge, with special reference to the carbon content, and that, as a consequence, it is fed with such specially selected raw materials as pure iron, nickel and chromium. It should be stressed, however, that each type of furnace can often handle the work for which the other is particularly suitable, and that overlapping is often desirable for commercial reasons, depending upon the proportions of output in each case.

The h.f. furnace is much more expensive than the arc equipment, but it works quicker, has a bigger output in the long run, and its electricity consumption is rather less. It is now available in sizes up to 6 tons, but a very popular unit is the 5 cwt. (200 kW) equipment. This will yield a melt every hour, but to produce 6 tons per day by arc melting it would almost certainly be necessary to install a basic-process 30-cwt. furnace loaded at, say, 750 kW. The charge takes four or five hours to melt, and the much reduced input for part of the time results in a poor load factor. With the acid process the performance is much quicker. There have been very few alterations in the essential design of the h.f. furnace in recent times, and standard equipments are increasingly contributing to the war effort by producing heavy armoured plate, etc.

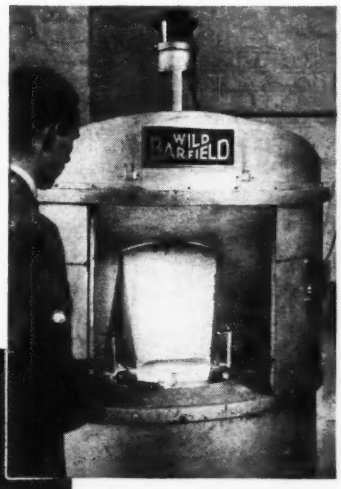
Supply of Energy

For commercial reasons all large h.f. furnaces are dependent upon a motor-generator for their supply, but the spark-gap method of supply offers considerable advantages in connection with small equipments, mainly in the attainment of very high temperatures rapidly and in special high melting point applications. In a 35-kVA spark-gap unit 18 lb. of steel can be melted in 40 minutes, while in a 7-kVA unit about 5 ounces of platinum can be melted in, say, 45 minutes.

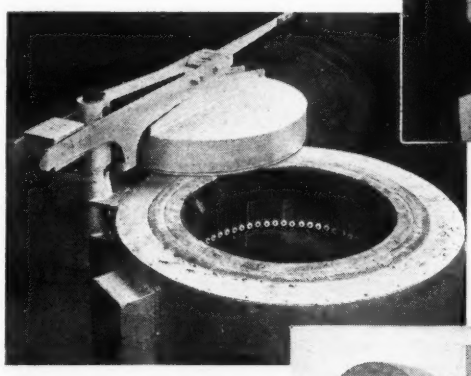
One of the largest arc furnaces installed in the country represents the trend of design towards simple maintenance and construction to enable an ordinary maintenance staff to effect repairs. It is a 25-ton direct-arc equipment served by a 7,500 kVA transformer. It has an automatically controlled hydraulic regulator for the electrodes, a removable hearth for top charging, hydraulic control for hearth withdrawal, pouring and slagging, and slagging-door and roof raising. Incidentally it is worth mentioning that American manufacturers appear to prefer to rely on the electric motor rather than on an oil-pressure system for the electrode operation. The arc furnace is also well suited to copper melting; a 5-ton equipment engaged on such work consumes 290 kWh and 3½ lb. of electrode per ton of copper melted. The low-frequency induction furnace is

now doing good work in producing brass for cartridge cases, the usual sizes employed being 600, 800 and 1,200 lb. The last is capable of melting half a ton of brass in an hour, with a consumption of 220 kWh per ton.

More recent developments are the rocking resistor and rocking-arc furnaces in which the resistor or electrodes run centrally through a horizontal cylindrical melting chamber which is practically sealed during melting so that an almost non-oxidising atmosphere is maintained while rocking of the chamber results in the charge being brought into contact with every part of the lining to ensure extremely rapid heating by conduction as well as by radiation, and powerful stirring during the melt to ensure uniformity of the mixture. Such furnaces are particularly suitable for the production of very high-grade cast-irons for piston rings and cylinder liners for aircraft engines, lorries, etc.

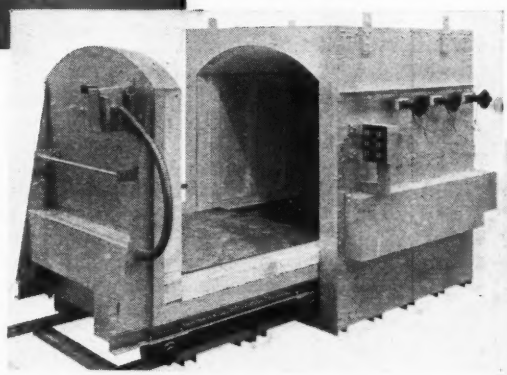


Wild Barfield electrode salt bath furnace



"Metalectric" vertical forced air circulation furnace (left)

Non-ferrous pre-heating work for rolling, extruding, etc., for billets and for forging operations is essentially a speciality of the resistance furnace, with certain modifications, mainly in connection with mechanical handling. On the whole such furnaces and modifications are so closely allied to those engaged on heat-treatment work, which we shall now deal with more fully, that it is hardly necessary to refer to them in detail by classification according to the processes.



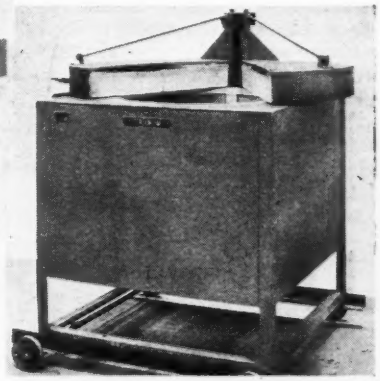
Preheating belongs essentially to the resistance furnace field; a semi-portable preheating equipment

Heat Treatment

The inherent advantages of automatic control which we have so many opportunities to stress in connection with so many electrical developments is certainly the keynote of success in the case of heat-treatment furnaces. The high degree of uniformity of heat distribution possible only in the case of electric heating is an admirable subject for thermostatic and pyrometric control. Apart from the highly creditable achievements in the development of sensitive control of temperature and time, much is being done to add to the accuracies of this new form of "machine tool" by way of zoning the heating chambers and giving each heating zone its own independent sensitive control. An outstanding example of zoning is the modern treatment of such irregular forgings as gun tubes, and a particularly interesting aspect of such division of control is the lessening of the great importance usually paid to electrical loadings.

The days are past when we could draw definite relationships between types of furnaces and their applications, and to avoid confusion we prefer to think of the two main types of heat-treatment furnaces—batch and continuous—each of which has many adaptations and modifications dictated by processes and handling requirements. There is little point nowadays in detailing the various common applications of the electric furnace, such as annealing, tempering, hardening and normalising, and we feel that the best way of presenting a reliable picture of so broad a subject is first to deal with the major problems which have confronted the furnace manufacturer and then to define a few of the rather special applications.

The inevitable stoppage of the supplies of elements and element materials to this country as the result of the war, first of carborundum elements for the highest temperatures and then of "Kanthal" from Sweden for the, say, 1,000 to 1,250 deg. C. temperature range, presented the furnace manufacturers with some formidable problems which, to their great credit, they have already overcome almost entirely. The difficulty with regard to the carborundum element has been met by a return to the American "Globar" in connection with which work is still proceeding towards making a more satisfactory joint between the very fragile resistor and the high-conductivity end pieces. Chrome-aluminium alloys, rather similar to "Kanthal" and equally successful, are now obtainable from steel manufacturers both at home and in America.

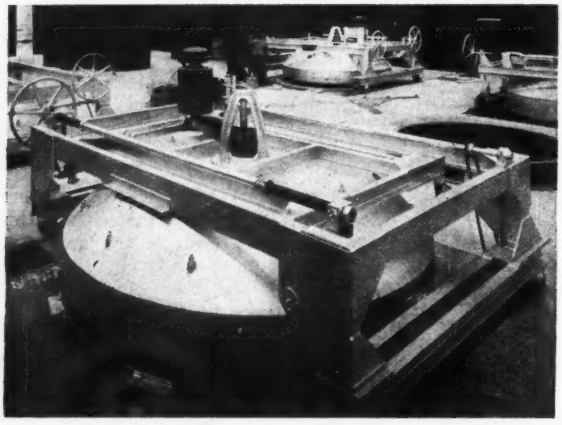


A Catterson-Smith vertical annealing furnace for copper-clad steel (with forced air circulation)

There are slight divergencies between the recommendations of manufacturers regarding the classification of elements in respect of operating temperatures; but we think the following is a fair résumé of general practice:—Up to 1,000 deg. C. nickel-chrome; up to 1,250 deg. C. alloy steel wire; up to 1,300 deg. C. alloy steel strip; and up to 1,400 deg. C. carborundum. Temperatures above 1,400 deg. C. are, in the melting field, served by the arc and h.f. furnaces.

From the structural aspect we should say that developments in connection with the handling of materials under treatment have had the greatest effect on modification of furnace design and construction, and recent developments

in this way can be regarded from two angles: handling at high temperatures and in controlled atmospheres, and handling arrangements which facilitate loading and unloading. We need concern ourselves only about the former type, although the latter contributes in no small manner to the idea of the modern electric furnace as a machine tool. A wartime revival is the rotary-hearth furnace which seems to be ideal for the "synthermal" treatment of large numbers of components. The hearth is power driven at



The main advantages of forced air circulation lie in rapidity of heating and even heat distribution; a Wild Barfield equipment

variable speed and a predetermined speed affords perfect consistency of the product for annealing, hardening, etc. Then, for small components, such as screws, we have another recent development, the rotating-drum furnace. The revolving drum often has a screw conveyor within it so that the components are both tumbled and conveyed.

No doubt the biggest field for handling developments is represented by the continuous furnace which is often associated with zoning and cooling arrangements. Here the problems lie principally in the careful selection of the conveyor-system for successful operation in the high temperatures. There are the conveyor-belt, pusher-gear and roller hearth equipments, all with precise control of conveying speed through the furnace. A peep into the near future shows us a double-ended horizontal furnace which can be charged from each end and a gear for handling flat aluminium slabs, automatically removing one slab at a time from the bottom of a one-ton pile.

Controlled Atmospheres

The consequences of the oxidation of products under heat treatment in normal atmospheres are such that there is hardly a process which cannot be effected beneficially in a protective atmosphere selected specially to counteract the reaction of the metal under treatment. Recent development has taken place in two fields—the application to batch type furnaces and really bright thermal treatment. In the former case the idea is to eliminate to a reasonable degree oxidation, scaling and decarburisation, for which purpose it is usual to introduce town gas. As, however, a perfectly bright finish cannot be expected from furnaces of this type, is it not a waste of money to introduce a *perfect* atmosphere to produce results which are partly undone every time the furnace door is opened? In the continuous furnace, however, the very nature of the process permits the purging of all air from the chamber and the maintenance of a proper protective atmosphere all the time so that it is worth the trouble and expense of introducing special gases.

There is hardly an industrial heat treatment process involving temperatures up to about 700 deg. C. which cannot more effectively be carried out with forced air circulation within the furnace chamber. The two principal advantages of this are, first, greater rapidity of heating and more even distribution of heat. The major recent developments in forced air circulation are those upon which experimental work is being done on the fan and air duct system. To cite one problem alone in this connection, the different calculations involved for circulating hot air and cold air (indeed, there is a different set of conditions for every temperature in each furnace) is a reminder that the furnace manufacturer has to be at once an electrical engineer, a chemist, a metallurgist, and a physicist. By far the biggest developments in forced air circulation have been coincident with the development of the light alloys industry, and this applies with regard to each of the two main avenues of the development. On the one hand we have the general improvement effected in most processes, while on the other hand there are alloys, notably of magnesium, which could not in any case be treated at high temperature in a normal atmosphere.

Before the introduction of forced-air circulation most electrical heat-treatment work at comparatively low temperatures and where rapidity of heating was all-important was effected in salt-bath furnaces often heated by immersion tubes. To some extent it was the disadvantages of the salt bath furnace which led to the development of forced-air circulation.

Consequent upon the recent introduction of new high-melting-point salts, however, we now have a new salt bath development suitable for heat treatment up to 1,350 deg. C. The salt is heated on the arc and electrode principle, and conspicuous success has been obtained in the heating of high-speed steel tools without the slightest oxidation.

Spheres of Usefulness

The development may be regarded as still rather experimental. The particular sphere of usefulness of the new bath in the treatment of essential parts of the tool which are integral with the whole rather suggests two separate fields of development, namely, the salt bath for individual treatment and the controlled atmosphere furnace for mass treatment. The point to remember is that even in the inert gas furnace a trace of burning still takes place, but the last word has not yet been said in this development.

To cite a few industrial applications in connection with which the electric furnace is giving very special service at the moment, we must first mention bright annealing. In a works producing sheets for the component manufacturers for stamping and deep drawing we recently saw an interesting bright annealing installation consisting of a vertical cylindrical 15-cwt. furnace loaded at 50 kW and housed with a number of cooling and preheating pots in a trench. Formation in the trench in this way affords a considerable degree of heat recuperation from the cooling to the preheating pots. Continuous furnaces are particularly suitable for bright annealing and some particularly successful applications are in the continuous bright annealing of wire. Nitriding involves the heating of special steels in ammonia, so that a very hard skin is formed by the combination of the outer layer of the metal with the ammonia. Both horizontal and vertical furnaces are successfully applied to this process and we have seen some vertical pit furnaces for nitriding crankshafts and a twin-hearth furnace for cylinder liners in which the heating chamber runs on rails.

Carburising involves the heating of steel products in a carbonaceous mixture, so that the surface absorbs carbon and can thus be hardened by sudden cooling. Batch-type furnaces are readily adaptable to this process.

For their help in the investigation which led to this article, we are indebted to the General Electric Co., Ltd., Birmingham Electric Furnaces, Ltd., Metaleotric Furnaces, Ltd., Electric Furnace Co., Ltd., Wild-Barfield Electric Furnaces, Ltd., G. W. B. Electric Furnaces, Ltd., and R. M. Catterson-Smith.

The Electric Motor

Its Aid in Increasing Production

The great versatility of the modern driving unit is a major factor in the electrical industry's stupendous war effort

NOT long ago we published a series of "Motor Survey" articles and since that time we have been constantly encouraged by reports of the help received from the articles by works engineers and others in the selection of motors for specific driving duties in connection with the equipment of new factories and the conversion of existing installations as part of the nation's war effort.

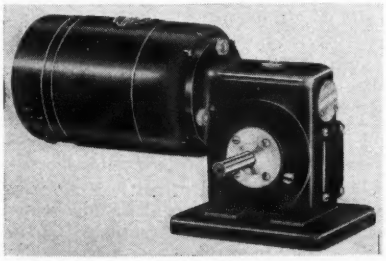
Partly for these reasons, but also because of the need to-day for many sacrifices to ensure speedy production, we make no attempt to discuss details of motor design in this article, beyond stressing the more detailed help available from the articles

A 150-HP variable-speed drive for rubber calender

referred to in connection with to-day's peculiar problems; we are more concerned with the broader subject of the great versatility of the electric motor.

Ideas on the relative values of efficiency—indeed on the very interpretation of the word and on the many details which contribute to it—vary so widely that it is impossible to state positively the real goal to be aimed at in this respect. Much can and, indeed, under to-day's conditions must, be sacrificed in mere technical efficiency, but satisfactory electrical performance must always be the dominating factor in selection. The performance, however, is all too often just taken for granted.

Rating depends on permissible temperature rise—there can be no two ways about that. All the same, it is a fact that is not easily grasped, despite the fact that all reliable specifications, including, of course, the British Standard Specifications, are based

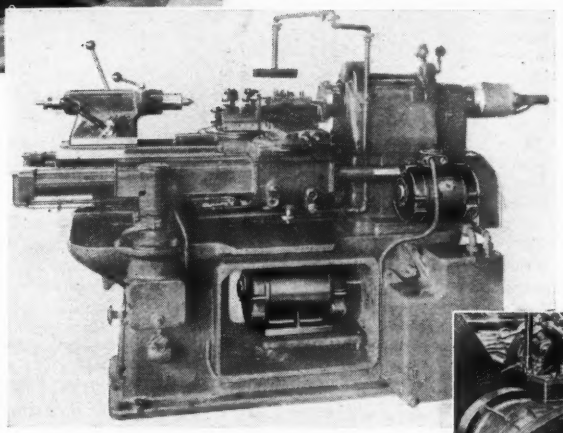


Geared motor unit with single worm reduction

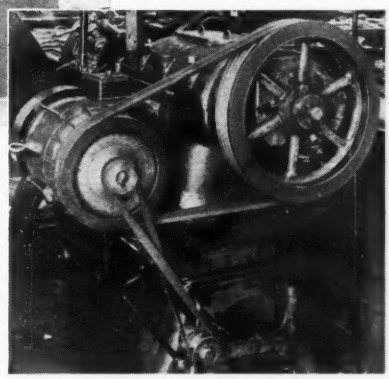
on this fundamental. Obviously, then, heat dissipation is of importance and, in consequence, so are the modern schemes to permit higher working temperatures by the use of special insulating materials such as asbestos and glass. It is vital, too, that ideas which have become fixed about relative performances should be uprooted. For instance, the older guide for selection—slip-ring motor for high starting torque and squirrel-cage motor for low starting torque—should be modified in accordance with the modern developments which we have dealt with.

Again, considerable misunderstanding exists regarding the influence of types of enclosure on output and, to emphasise the necessity of correcting such misunderstanding, it is sufficient merely to refer to the serious loss of output which can be brought about by the clogging up of a misplaced ventilated motor in a dirty atmosphere. As regards maintenance, to-day, if not at all times, minimum of servicing compatible with satisfactory electrical performance is a requirement which is almost as important as efficiency. One of the industry's highest authorities has said: "It is easy to design a motor for any known set of service conditions, but it is extremely difficult to ascertain the service conditions." We know of many cases where it would be quite impossible to ascertain the service conditions because it is anybody's job to look after the motors.

While the widely diversified services which motors are required to perform suggests a necessity for a wide choice of types, it is a fact that almost any motor of appropriate size and speed will give reasonable satisfaction in an enormously varied range of industrial drives, providing there is not too much insistence upon purely technical efficiency. Further confusion is caused by the call, on the one hand, for production by manufacturers to a common specification and, on the other hand, for range limitation by individual manufacturers. We are more concerned with the idea of range limitation, because over a number of years recently we have seen a merging of some of the proved ideas born out of such limitation, and this



Squirrel cage motor driving a high-efficiency lathe

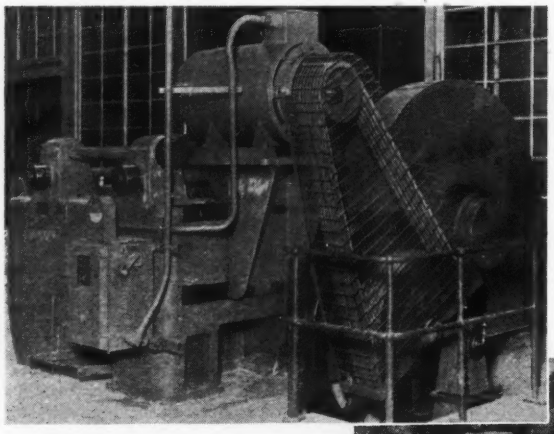


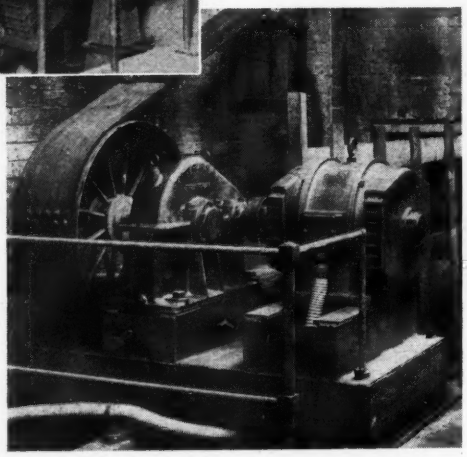
Multi-tool lathe converted to a two-speed drive from a surface-cooled motor

can be regarded only as a healthy state of affairs from the national viewpoint.

If we view standardisation, then, from the range limitation angle, the problem is to find a common basis on which to construct economically the ideal ranges of motors suitable for the majority of industrial drives, leaving the relatively few exceptional applications to be met by special designs. Prevailing ideas on range limitations stretch in one direction to advocacy of one motor for all purposes and in the other direction to a point where a manufacturer's price list includes details of about 1,000 AC motors from 1 to 100 HP, all designated "standard."

The term "standard" motor conflicts with the broader idea of standardisation too, and we much prefer to use the term general-purpose motor, about which equipment we shall say something later. Still more trouble is caused by the apparently opposing ideas on standardisation brought about by complementary developments, for whereas a major idea in range

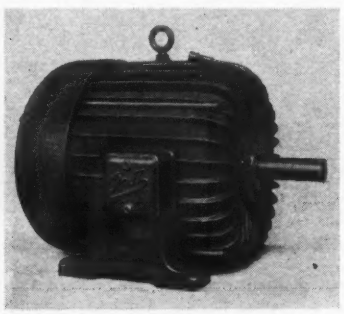




A 35-HP "high torque" motor driving a forging machine Right: A 50-HP, 1,450-RPM "high torque" motor coupled to reduction gear

limitation is to reduce the variety of housings as much as possible, it is becoming more and more the practice to fit the motor to the machine, and this tends to increase the variety of casings to suit all manner of mounting requirements and applications.

It will be seen from the above how easily an incorrect attitude can stultify the versatility of the motor, and without specific reference at this stage to the general-purpose motor we consider that some of the best contributions to versatility are bound up with schemes for the standardisation of components, as against the earlier method of keeping full ranges of individual motors in stock, a practice which to-day could hardly be adhered to. A comprehensive policy of stocking standard components results in the possibility of making up on demand any type of motor including certain specials, and to illustrate this we may mention a particular range of one manufacturer in which there are twelve rotor diameters, each with four lengths, thus providing for forty-eight frame sizes. To complete the versatility of this standards system a series of housings can be devised to cover with equal facility all varieties of enclosure from flameproof to open protected.



Typical totally enclosed fan-cooled squirrel - cage machine

We feel, however, that the greater value of such schemes lies in their extension to the idea of standardisation by industries, *i.e.*, the ready production of basically standard motor ranges, each with special features to suit the applications or conditions pertaining to one or a group of industries. The trend to-day is for the installation engineer to have to provide driving motors for all sorts of machinery of which it is essential that he must be kept in ignorance, apart from a few driving characteristics, and it is by the comparison of such characteristics with the applications detailed comprehensively in our motor survey that the help to which we have referred is being obtained.

We regard the general-purpose motor as the direct outcome of those many, if conflicting, ideas bound up with that of versatility, and because of this we cannot urge too strongly the necessity for getting rid of the notion that this class of machine is merely a "ready made" or "off-the-shelf" type of equipment.

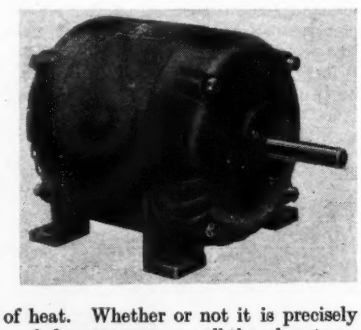
According to different manufacturers' viewpoints the general-purpose motor is aimed at a varying number of particular requirements, and in contrast to the ready-made or standard motor it has a definite relationship to its designated applications in a similar manner to the "special." We do not wish to suggest, however, that the motor cannot be purchased off the shelf, but there is all the difference in the world between the ready-made motor designed for a recommended use and the motor which is sold without the slightest knowledge of the service for which it required.

Because of the widely differing ideas of manufacturers in the choice and number of industries to be catered for by the general-purpose motor it is almost impossible to define this product of the idea of versatility and again we recommend reference to the specified applications in our motor survey. It would be useful, however, to refer to some of the features of general-purpose motors by different manufacturers. One idea is a design to obtain the best all-round performance out of the squirrel cage principle, with efficiency and power factor graded to give the most economical results in normal industrial drives, having regard to the average loads to be carried. In another case a stock delivery scheme embraces three ranges of motors calculated to cover almost the whole of the industrial demands. The ranges are screen protected, totally enclosed fan-cooled, and fractional-HP with drip-proof features.

In another instance the idea behind the production of comparatively small motors is that the horse-power range shall be covered by the smallest possible number of frame sizes, and that the frames must be externally identical irrespective of the type of winding or the voltage. By the limitation of frame diameters it is very simple to provide a great variety of flange and spigot mounting end shields which can be identical throughout the range.

The totally enclosed fan-cooled motor is increasingly being regarded as the general-purpose motor of the future, largely because of the fact that in the majority of instances it can be installed close to the job without regard to the local conditions. It is the type of motor adopted where one design only is advocated. The fan-cooled motor appears to have been born out of the limitations of the totally enclosed motor which has many advantages by way of almost absolute reliability, although its greater active material taxes the normal facilities for the dissipation of heat. Whether or not it is precisely true to say that the fan-cooled motor possesses all the advantages of both the totally-enclosed motor and the ventilated motor, we should say that it is certainly an excellent compromise. The fan-cooled motor obviously has a greater output than the totally enclosed motor of corresponding frame size.

Normal foot-mounted motor with standard ventilating end shields



There is little doubt that if the advantages of the plain totally

enclosed motor were not off-set by the limiting factors of size, weight and cost, its adoption in industry would be much more general. Certainly from the viewpoint of protection it is ideal, and we know of one manufacturer who advocates it unconditionally, for the smaller sizes at any rate, on the score of reliability. It certainly supports the keynote of this article, for it is probably the one and only type of motor that will give entirely satisfactory service in any position and under any service conditions. To say the least, it is a good compromise between economic and technical problems.

From some aspects one can see in the general-purpose motor an attempt to call a halt to the ever-increasing variety of housings and methods of protection. From the older and well-established field of open protected and enclosed motors of a few years ago we soon found ourselves confused by such terms as louvre ventilated, canopy protected, screen protected, drip-proof, splash-proof, and so on. It is almost impossible to lay down a general rule as to the degree of mechanical protection necessary without a definite knowledge of the conditions of each particular case. To illustrate this in connection with boiler-house motors, it may be found that in some instances the existing degree of cleanliness justifies the protected type motor while in others dirt, damp and dripping water necessitate the totally enclosed machine.

The fact remains that the greater the protection provided the more cooling is impaired. The system of ventilation is closely related to the classification of motor enclosure; indeed it is a fundamental consideration of design, but motor design without a fan is necessarily a compromise between the ideal rotor diameter for electrical performance and the diameter necessary for inclusion of a fan. With a fan the motor can be designed without the restrictions consequent upon the necessity of obtaining sufficient airflow to dissipate heat.

Much of the earlier success of the electric drive was due to the fact that the great majority of factory demands were for constant speed which suited the electrical design because of the simplicity of compounding in the case of DC and because of the synchronous speed tie in the case of AC. In spite of to-day's demands for variable speed those constant speed considerations should still be regarded as all important. The electrical industry has shown, however, that there is no speed control problem in connection with which the electric motor cannot go one better. The Ward-Leonard system for DC and the commutator motor for AC are alone sufficient support for our versatility theme, but we must not forget the reasonable speed variation afforded by the normal slip-ring motor which meets satisfactorily the vast majority of speed variation demands. Further, we must point to the ease with which exceptionally high speeds and low speeds are catered for by the frequency changer and the geared motor respectively.

Finally, we consider that the most forcible expression of the versatility of the electric motor is in connection with the many highly successful factory driving conversion schemes which are being undertaken to-day. The problem is nearly always to apply a modern high-speed drive to a low-speed shaft and the trend is to install a self-contained V-belt reduction unit complete with a high-speed motor and countershaft.

For their co-operation in the preparation of this article we are indebted to Bruce Peebles & Co., Ltd., Ransomes, Sims & Jefferies, Ltd., Metropolitan-Vickers Electrical Co., Ltd., Kandem Electrical, Ltd., Klaxon, Ltd., English Electric Co., Ltd., Flather & Co., Ltd., A. Reyrolle & Co., Ltd., Brook Motors, Ltd., Horace Green & Co., Ltd., Delco-Remy & Hyatt, Ltd., Oerlikon, Ltd., Laurence, Scott & Electromotors, Ltd., Higgs Motors, Ltd., Bull Motors, Veritys, Ltd., Normand Electrical Co., Ltd., and other manufacturers referred to in our Motor Survey articles.

NEW BOOKS

Works Boiler Plant. By F. J. Matthews, B.Sc. (Hons.). Pp. 184; figs. 88. Hutchinson & Co. (Publishers), Ltd., Hutchinson House, Ireland Yard, London, W.C.2. Price 10s. 6d.

This handy little volume of 184 pages is intended mainly for those in charge of small industrial plants. It is concise, has a very practical outlook, and contains numerous diagrams, while the emphasising of salient points in heavy type is a helpful feature. Steam generation and the effects of temperature are first explained, followed by a chapter on combustion showing, with helpful diagrams, the stages in the burning of coal and how losses, especially excess air, are minimised. One chapter deals with the selection of coals and the practical effect of volatile matter, ash, calorific value, ash fusion temperature, etc. The wetting of coal—now a common practice, is discussed, and some practical hints on coal storage are included. Only a few pages are given to mechanical stoking, which appears somewhat brief.

Next comes a chapter on superheaters, economisers, air heaters, and surface condensers, showing clearly the economies achieved by suitable plant and giving practical data of operating problems, followed by an important chapter on heat economies such as good insulation, the recovery of condensate, and methods of thermal storage. Boiler engineers will welcome Chapter VII on boiler feed treatment to avoid troubles from scale, corrosion, condenser fouling and priming. The author has taken special pains to use simple chemical language. The care of safety valves, gauge glasses, high and low water alarms, feed pumps, etc., is dealt with in Chapter VIII, and various types of feed water regulators are described with clear diagrams.

An account of some problems of operation and maintenance is well worth reading. Rapid steam raising, cleaning and banking fires, soot deposits and external corrosion are included, and general hints on fire-bed control are given due prominence. The final chapter on boiler plant testing is perhaps rather brief, but essential points are given. The author rightly emphasises the keeping of careful records and periodical testing, to increase and maintain efficiency. In general, the book appears to be well worth the price and, although it does not deal with high-pressure plant, should have a wide appeal.—A. B. O.

Science versus Materialism. By Professor R. O. Kapp. Pp. 280. Methuen & Co., Ltd., 36, Essex Street, London, W.C.2. Price 10s. 6d.

Is matter the only reality? The author attempts to solve this problem in a way that a layman can understand, and he leaves no room for doubt as to his objective. He does not consciously burke any of the issues involved and his definition of matter is comprehensive and free from ambiguity. He defines matter as everything which has location in any system of dimensions. He does not so precisely define science, but Karl Pearson's definition, "the aim and method of science is the classification of facts and the formation of absolute judgments upon the basis of this classification" is perhaps good enough.

There can be little doubt in the reader's mind that the author has enjoyed himself enormously even if in places he has felt it necessary to take an argument step by step, as one does in an elementary class. His enjoyment is reflected in his style, which makes the book the most readable on the subject we have come across. Further, it is a subject which should interest the engineer, and it is to be hoped that this book will introduce many to the problem. An engineering training teaches one to question and demand answers which satisfy test and reason, and the world to-day is groaning under the results of years of an unprotesting acceptance, without reason, of assertions on such subjects as those under discussion here.

The author has laid stress on precise definitions. The argument he adopts to justify his use of the term "specification" is a good example of a method of approach. He then sets out to prove that things in the organic world are specified, and that things in the inorganic world never are.

Space precludes the possibility of giving even an outline of the argument which leads the author to a suggestion for a more general term than mind, life or spirit to express non-material reality. Some will challenge the need for a new name, being satisfied that spiritual is the opposite of material. Others will consider the name "God" all-sufficient, but no one interested in scientific reasoning can object to the introduction of a new term with a precise definition in order that discussion can proceed with a minimum of ambiguity. In this review it is perhaps better to leave the reader of the book to find the interesting term (and its associated parts of speech) which the author proposes for use "whenever we need a positive means of distinguishing life from matter."—P. G.

Shorter Notices

Steam Power Stations. By Gustaf A. Gaffert. Second edition. Pp. 582; figs. 379. McGraw-Hill Publishing Co., Ltd. Price 31s. 6d.

Industrial Electrochemistry. By C. L. Mantell. Second edition. Pp. 656; figs. 236, with 80 tables. McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 38s.

Principles and Practice of Electrical Engineering. By Alexander Gray. Revised by G. A. Wallace. Fifth edition. Pp. 586; figs. 471. McGraw-Hill Publishing Co., Ltd. Price 28s.

Television Broadcasting. By Lenox R. Lohr. Pp. 274; figs. 88. McGraw-Hill Publishing Co., Ltd. Price 21s.

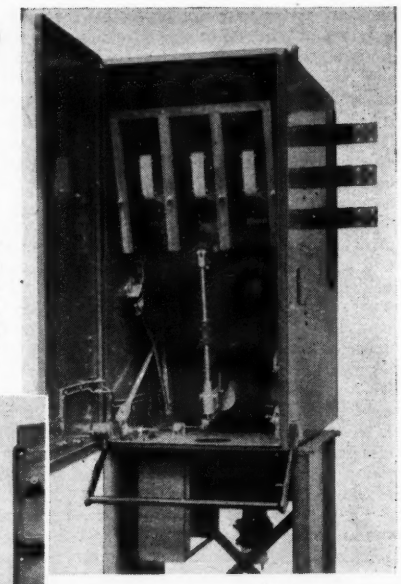
Understanding Radio. By Herbert M. Watson, Herbert E. Welch, and George S. Eby. Pp. 603; figs. 379 and plates. McGraw-Hill Publishing Co., Ltd. Price 20s.

Introduction to Electricity and Optics. By Nathaniel H. Frank. Pp. 398; figs. 240. McGraw-Hill Publishing Co., Ltd. Price 24s. 6d.

Industrial Switchgear

Planning and Maintaining an Installation for Wartime Production

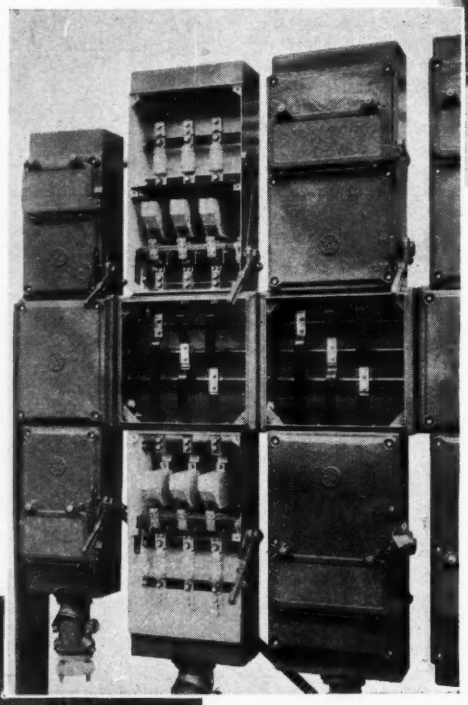
By J. M. Goodall, M.I.E.E.



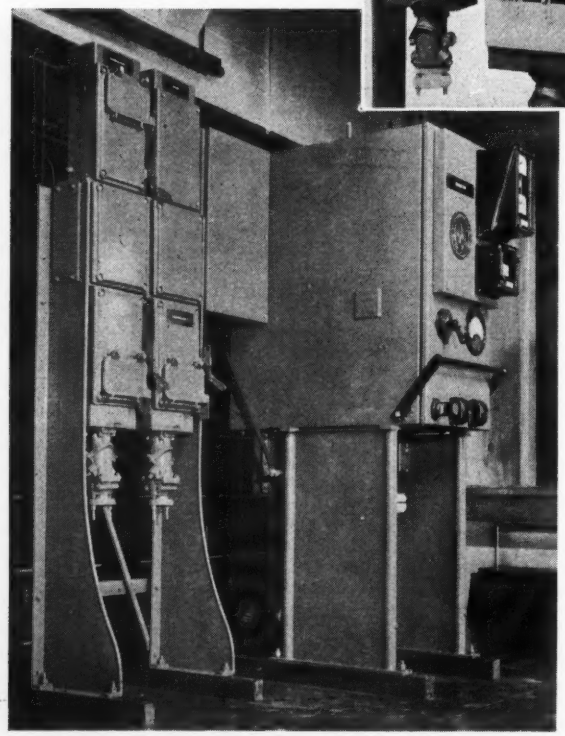
B.T.H. air-break switchgear tested for 15 to 25 MVA

OF the three essential services in a modern factory (electricity, gas, and water) electricity performs the widest range of tasks and makes the greatest contribution to production. In a plant occupying, say, 100,000 sq. ft. experience has shown that the maximum economy in distribution and reliability of supply can be obtained if electrical energy is fed from two substations, preferably at opposite corners, equipped with a suitable number of step-down transformers, using standard units of 500 kVA. For a 400-V factory distribution system, such an arrangement establishes an economical short-circuit level of between 15 and 25 MVA, according to the number of transformers in parallel. With one or more spare 500-kVA transformers and a 400-V interconnector between substations, an interruption of supply can be caused only by conditions for which it is not practicable to legislate.

At the 400-V substation switchboards the busbars should be sectionalised with an air-break switch or link, the circuits being disposed symmetrically on either side. This provides means of shutting down half the board for extension or for cleaning and inspection, which should be carried out at reasonably regular intervals (say every three to six months). Under war conditions this is particularly necessary, as only by strict routine maintenance can the plant be expected to stand up to the strain of full capacity production.



Right: A typical switch-fuse unit incorporating slow-make and quick-break switch with contactor-type contacts and three series h.r.c. fuses. Below: A distribution board at a feed point with an air-break switch and h.r.c. fuses



Air-break switchgear is strongly recommended for industrial service because of the small amount of maintenance required as compared with oil circuit breakers. The gear, comprising a dust-tight dead-front interlocked cubicle, is equipped with h.r.c. plugging type air circuit breaker, insulated busbars and connections and instrument transformers. By using silver plating on all contact surfaces (except those subject to arcing) and the insulating of all busbars and connections, this gear can be operated for long periods before maintenance becomes necessary. Such equipment is economical for 400 A and above, but for smaller currents air-break switches and high rupturing capacity fuses may be used.

The factory load should be divided into groups, each with a maximum capacity not exceeding 300 to 500 A, due allowance being made for diversity and the difference between the ratings of the motors installed and the anticipated actual loadings. The division of the load to correspond with the various processes will, in many cases, form natural feeding groups, varying in capacity from, say, 100 to 500 A, but it is preferable to divide a process between two or more feeder groups, so that the loss of one feed does not shut down the whole.

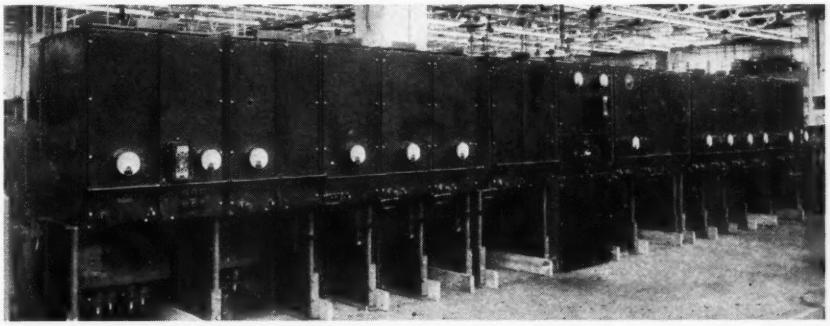
Another arrangement is to have multiple manufacturing units, each covering the whole of the processes, operating independently with perhaps a common inspection department. Whichever scheme is adopted the circuits should be grouped so that one group or more may be fed from the appropriate substation by an economical cable of, say, 0.3 to 0.5 sq. in. cross-section.

To ensure freedom from mechanical damage p.i.l.c. and s.w.a. cables are usually employed, preferably run in trays on the roof principals or against the valley girders, and terminating at the approximate load centre of the group or groups to be fed. The switchgear at the feed points would comprise an ironclad switch for the incoming cable, and a distribution board with an ironclad air-break switch and h.r.c. fuses from which cables would be run to the individual circuits forming the group; alternatively, two or more cables may leave the board and be connected to overhead busbars.

In general a feed point would be supplied by only one cable from the substation, but there are certain advantages in combining two feed points, connecting the two incoming switches to a busbar with a link normally open at the centre. By running the two feeder cables from different substations, an emergency or alternative feed is available for each feed point.

A typical ironclad switch-fuse for the feeder points illustrated comprises a ruggedly constructed slow-make and quick-break switch with contactor-type contacts and three series h.r.c. fuses. The switch-fuse units are mounted above and below an ironclad busbar chamber, all busbars and connections being covered with moulded insulation. Ammeters may be fitted to each circuit, and cable boxes may be of the universal type for either upward or downward cabling. Switchgear of this kind is made by a number of firms and is usually sold with a guarantee that the complete unit will make, carry, and break up to 25 MVA.

The importance of employing switchgear of adequate rupturing capacity in industrial installations cannot be over-emphasised. The use of 500-kVA step-down transformers will limit the short-circuit to an economical level, but with only two such units in parallel the short-circuit capacity may be approximately 20,000 kVA. For such duty h.r.c. switchgear is essential.



Air-break switchgear, of which this board is a typical example, is recommended for industrial service because of the small amount of maintenance required

The final distribution to the machines can be carried out by multiple cables in trenches or ducts from the feed-point switchboard, or by two or more larger cables (say 0.1 or 0.2 sq. in.) run upwards and connected to insulated overhead busbars. Of these two schemes, the overhead busbar arrangement is gaining in popularity, as cable trenches are liable to flooding and the collection of debris; also, by connecting the feeder cable to the centre of the overhead busbar, economy in distribution copper is achieved. A further advantage is that the machine tool layout can be readily changed or extended by merely removing or adding plugging fuse boxes, whereas, with a cable distribution system, the rearrangement of the cables is a major operation and the cable trenches are usually in inconvenient positions.

The overhead busbars are contained in a rectangular sheet-metal enclosure with plugging orifices every 12 to 15 in. along the length. A feed to an individual circuit is obtained through three h.r.c. fuses in a plugging fuse box located at a convenient point above the load, with either a flexible or a rigid dropper to the machine or circuit. H.r.c. fuses are just as essential at the distribution point as at the feed point, because, while the impedance of the group feeder cables and overhead busbars does effect some reduction in the short-circuit capacity it does not, except in unusual cases, limit it to a value which would permit the use of ordinary industrial-duty fuses.

The question of short-circuit level also arises, for which h.r.c. fuses should again be employed in the various distribution boxes; an alternative sometimes adopted is to install, say, a 100-kVA 400/230-V lighting transformer, the load being connected between phases. The impedance of the transformer limits the maximum short-circuit on the lighting distribution circuits to a nominal value and, by earthing the neutral, the maximum potential to earth is less than 140 V.

To obtain the maximum wartime production, the electricity services must be flexible and free from interruption, permit maintenance and extensions or alterations, and afford the maximum safety. Due regard must also be given to the necessity for economical expenditure on switchgear and cables.

In order to obtain the maximum benefit from a well-planned installation, attention should be given to maintenance facilities and the following suggestions are offered from experience:—(*a*) The plant engineer should be provided with a black and white framed diagram of the main electrical circuits and similar diagrams of the distribution circuits; (*b*) every circuit with fuses should be given a distinguishing number marked on the diagram, which must be scrupulously kept up to date; and (*c*) spare fuses (say 10 per cent.) of each rating should be held in an accessible place for renewals.

The importance of an efficient earth for the neutral point of the 400-V system, the advisability of an adequate section of copper in the earthing circuits, and the necessity for a copper earth circuit to each feed point are the matters that require attention. In a modern factory with a concrete floor, a high resistance earth is a real hazard to personnel and to the system. This condition is avoided by effectively earthing all motor starter frames, bearing in mind the necessity for an adequate section of copper in the earthing circuits. Many of the large electrical firms have made a special study of this class of work and have specialists who will make comprehensive recommendations. One such firm is the British Thomson-Houston Co. Ltd., to whom I am indebted for permission to publish the photographs of its latest air-break switchgear.

Solders and Fluxes

THE following points have been extracted from a series of technical leaflets compiled by Fry's Metal Foundries, Ltd.

For hand and machine soldering a fifty-fifty alloy of tin and lead is usual. Adding tin to lead reduces the melting point and facilitates the tinning of other metals.

All tin and lead solders begin to melt at 361 deg. F., but they lose their strength at lower temperatures; *e.g.*, the strength of a soldered joint in brass is reduced by 75 per cent. at 302 deg. The alloy becomes completely molten at from 363 to 446 deg. according to the B.S.S. grade. The addition of a small proportion of antimony increases the strength and improves the properties for most purposes, but needs careful control during manufacture, otherwise the solder becomes sluggish and brittle. For certain duties, particularly the soldering of zinc, an antimony-free solder should be used. Soft solders are widely employed to apply coatings by hot dipping, the flux and temperature of the bath varying with the metal dipped and the solder used. A covering flux for the bath prevents undue oxidation and loss of metal.

For soldered parts, such as in electrical work, that are subjected to temperatures above 212 deg. F., a high-conductivity tin-rich alloy melting at 457 deg., which can be used with safety fluxes, is recommended. A "safety flux" is one that has little chemical activity and therefore limited cleansing action; it is suitable for radio and other delicate electrical work. It is non-conducting and dries rapidly and the flux residue is harmless and is thus distinguished from "active fluxes," as employed for sheet metal and general soldering, which are speedy in action but must be cleaned off afterwards to prevent corrosion. A suitable compound of active flux and powdered solder is more effective than the two separately applied and forms an adherent tinned coating on greasy or rusty metal or on stainless steel, cast iron and even aluminium.

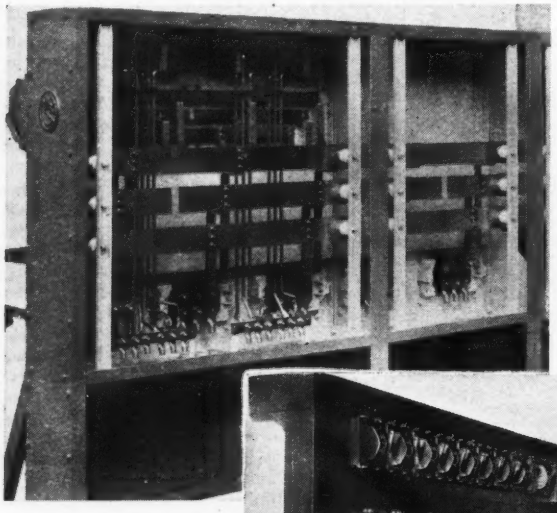
The less freely running lead-silver solders melting at 581 deg. are used with an active flux in connection with electrical machinery and hot-water appliances. Aluminium can be tinned often without scraping, it is stated, by rubbing on the heated metal a special solder recently developed by the company.

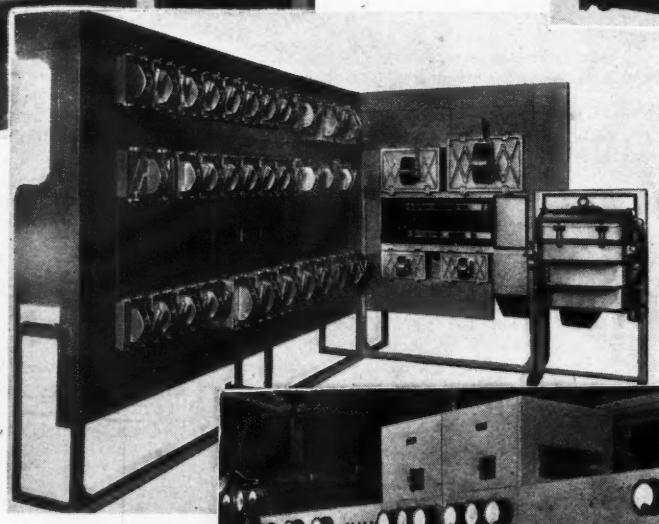
Switchgear for War Use

The Importance of Speed and Ease of Erection and Extension

THE proper choice of switchgear is most important for the efficient working of industrial plant. This is particularly true in wartime, when the national interest demands every precaution to secure continuity of supply under all conditions, by bearing in mind such matters as insulation security, making capacity and breaking capacity, strength of construction, general reliability, and safety of operators.

Of perhaps greater importance still, however, in what must still be regarded as the initial stages of wartime industrial production are features of the apparatus which make for rapid and simple erection, installation, extension and maintenance, with the consequent minimum requirements of labour and time. Much useful work has been, and is being done, by switchgear manufacturers on this side of design and, as this brief review will show, they achieve the desired results in a variety of ways.



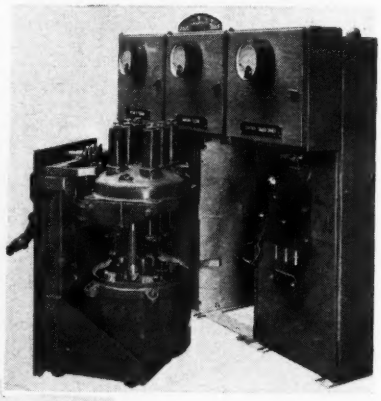


Back view of M & C cubicle type, double-tier, oil-immersed switchboard showing easy connection of outgoing cables, and (right) a typical Berry

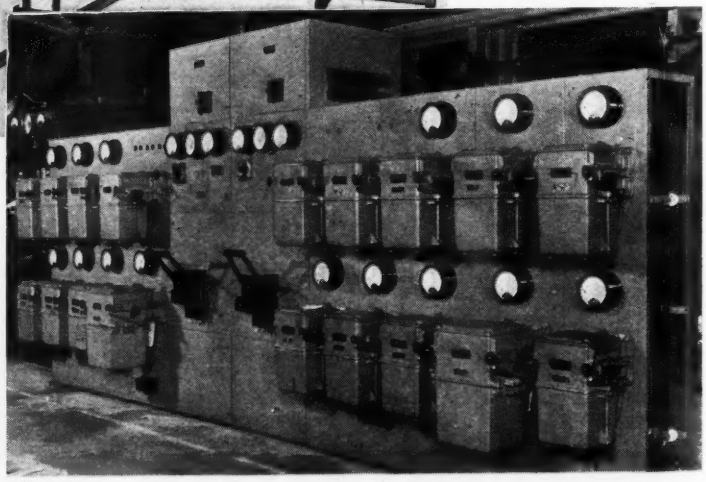
Unusually liberal spacing is, for instance, a point to which Simplex designers have paid special attention, while in the Berry " Ironsafe " switchboards rapid wiring of the switch units is facilitated by the provision of split-conduit entry boxes, and all the connections are accessible from the front, thus allowing the switchboards to be placed directly against the walls. Furthermore, future extensions (at either end) are provided for by appropriate drilling of the framework, busbars, etc.

All the Statter gear is designed with a view to easy installation, and to reducing assembly to the minimum, thus permitting rapid production and quick deliveries. This company's low-voltage ironclad non-draw-out oil-immersed circuit breakers, which are popular both for direct installation and for incorporating into switchboards, will readily fit any design of mounting and are particularly easy to adapt to any type of switchgear.

The jig-built components of the Reyrolle horizontal draw-out type C unit, which is designed for dealing with a supply at 6.6 or 11 kV with a short-circuit value of 100 or 150 MvA, ensure rapidity of erection on site, as well as ease of installation, while great saving of time in erection is achieved because the complete multi-panel fixed portion of a switchboard can be despatched direct to site. The minimum of erection work, too, is needed for the Metrovick truck type switchgear type CL, to mention just one of that company's models. The unit is intended for AC systems up to 100A at 650 V, and every truck is despatched completely assembled. Switchboards can be provided to include any desired number of units, while interchangeable trucks make it possible to use a spare to avoid interruption in the supply. The work of installation is similarly simplified by the design of the M & C cubicle type double-tier board, the leads from the breakers going down to a common terminal base and so permitting easy connection of the outgoing cables.

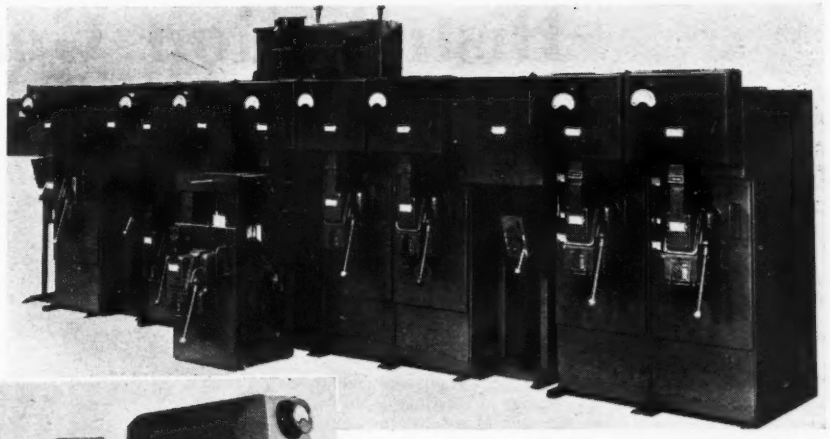


Ferguson, Pailin type " BV " board

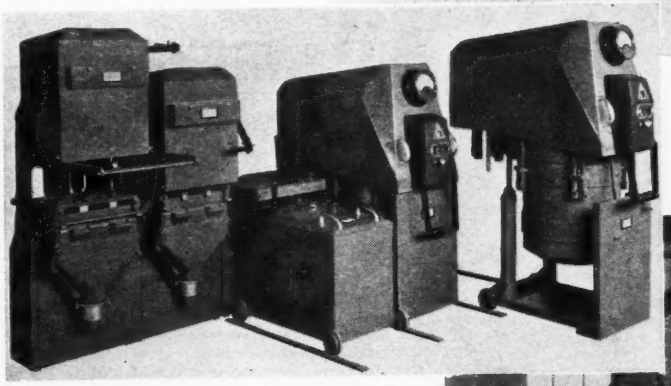


Brush switchboard supplied to the Milnrow Spinning Co.

Ellison gear is designed so that circuit breakers of from 20 to 4,000 A can be assembled in one switchboard from stock parts. Such an arrangement enables the gear to be despatched with the minimum of delay and extensions can easily be made from time to time. Another feature is the cabling arrangements. The tubular support stands, on which the various sections of the switchboard are mounted, leave a clear space under the busbar chamber for laying heavy cables from any direction. Where necessary, cables can also be brought to cable



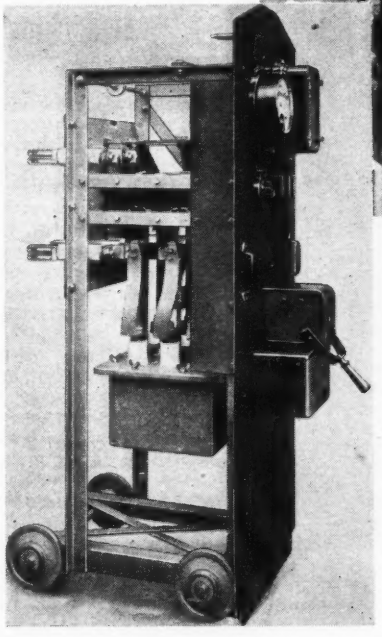
Statter "VTGR" e.h.v. metalclad, air-insulated industrial switchboard



Yorkshire Switchgear & Engineering Co.'s standard "IVI" switches (left), incorporating automatic oil circuit breakers of 150 MVA rating, together with two units of the plug-in oil-immersed isolator type

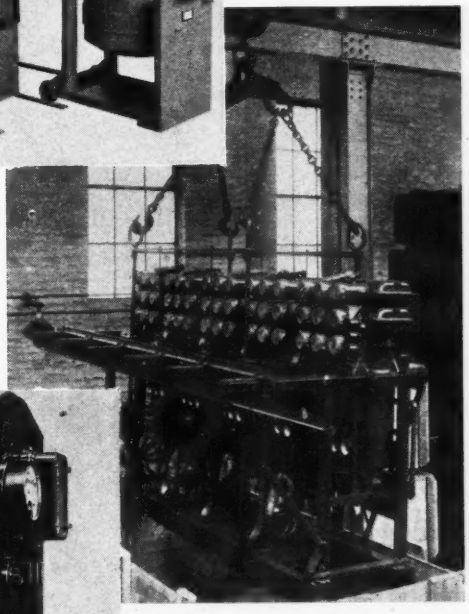
fittings on top of the busbar chamber. The cable fittings for armoured cables are split to enable the latter to be laid in position. The cable armour is secured by cone clamps and specially shaped connecting clamps hold the conductors securely without the use of solder. The principle of double isolation has been applied to each size of circuit breaker so that any breaker can be isolated from the busbars for inspection and maintenance without shutting down the other breakers on the board.

For certain situations, saving of space as well as time and labour is a matter of importance. Among the apparatus in which manufacturers have paid special attention to this requirement is the Bill h.r.c. fuse switch in which English Electric h.r.c. cartridge fuses are located over the switch blades so giving a shorter



Metrovick truck-type "CL" switchgear

unit. Ample wiring room is allowed by reason of detachable end-boxes and the switch is so designed that the cables are brought straight in and out, there being no obstruction. By employing a double-tier formation for the mounting of certain types of its horizontal draw-out oil circuit breakers the Brush Electrical Engineering Co. also secures a considerable saving of space. Them inimum of floor area is likewise required for the type "BV" metalclad units made by Ferguson, Pailin. These have short-circuit ratings up to 150 MVA on systems up to 11 kV. Besides having a very wide application for general high-voltage distribution and small substation use, they are also valuable for controlling high-voltage motors.



A complete fixed portion of a 5-panel, 11-kV, 150-kVA Reyrolle switchboard being packed

Apart from simplified installation it is essential that switchgear in use today should require only the minimum of maintenance. Because of this and also the simple and rapid erection possible, switchgear of the air-break type is very suitable for industrial service. Most of the manufacturers offer alternative oil-filled and air-break units. For instance, for the control of e.h.v. incoming supplies to factories and for e.h.v. distribution to substations, J. G. Statter & Co. can supply either their type "DOGR" metalclad vertical draw-out oil and compound filled gear or the type "VTGR" metalclad, air-insulated, drop-down, draw-out gear, according to whichever type is preferred by the purchaser and is best suited to local requirements. Both types are suitable for use on systems up to 11 kV and the former type up to 22 kV.

New type of contact employed in the "Salford" (G.E.C.) line contact breaker allows a larger section of metal and higher pressure between the contacts than the usual brush type. It takes the form of vee-shaped copper blades which fit into vee-shaped grooves in the contact block. Each blade carries approximately 125 A.

In the Yorkshire Switchgear and Engineering Co.'s "IVI" type switchgear, the busbar chamber and cable box represent the whole of the stationary portion. These are simple to install and can be provided with means for solidly coupling the feeder cable to the busbars (by plug-in links) until the remainder of the gear is delivered.

Distribution Gear

Standardisation and Unit Construction Facilitates Installation and Extension

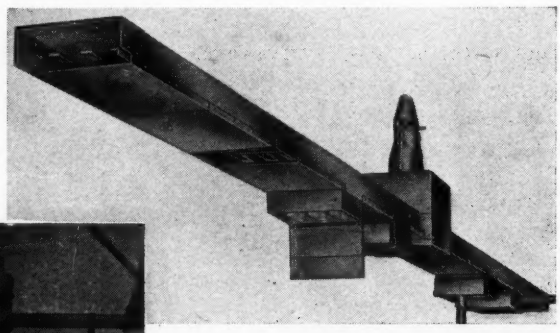
THE layout of production facilities and the scheme of manufacturing operations in a factory determines to a considerable extent the layout of the network and the most suitable types of distribution gear, on which the kilowatt load of the factory often has an important bearing also. While the nature of the work of the factory will, to some extent, govern the power distribution arrangements, these have, however, now reached a degree of standardisation which affords maximum flexibility and minimum interruption consistent with reasonable capital expenditure.

This general trend towards standardisation and metalclad unit construction is, indeed, proving of inestimable assistance to those now engaged in the planning of new, or the extension of old, installations to meet the requirements of the moment. Manufacturers now supply complete ranges of switch, fuse, busbar and other units to suit every purpose, provision being made for readily and neatly erecting them to form complete switchboards or distribution boards for either wall or floor mounting. Existing equipment can thus be extended with the utmost ease and economy, and adapter plates are available for connecting units of different sizes. To ensure an accurate fit between the various units some manufacturers, among them Reyrolles, go to the trouble of machining the junction faces. Standard junction faces also enable busbar chambers and oil immersed circuit breakers to be built up into self-contained units. If it is desired to have fuse circuits in one box, power fuse distribution boxes have a wide application and can be built to customers' requirements with isolators, if desired.

The boards can, of course, be delivered assembled or in unit sections, whichever is more convenient, and units for extension are always available from stock. The enclosure of all the current carrying parts in earthed metal casings and the system of interlocking eliminate risk of shock, and the method of construction enables the best use to be made of floor space, because it can be mounted close up to moving machinery. As all the units are dust-proof, maintenance is almost negligible, all adjustments being easily made from the front when the covers are open.

An example of the ways in which special attention has been paid to possible alteration and extension of the equipment is provided by the Simplex busbar chambers. These incorporate a system of sliding connections which permit the balancing of circuits to be altered and fresh connections to be added without any necessity to drill the bar or even to thread a connection on it. The design is entirely standardised so that bracket extension may be made to the existing chamber. Moreover, the main terminals are reversible, thus permitting differing approach angles for the larger calibres and avoiding unnecessary bends. The difficulties of wiring heavy switchgear can, incidentally, be solved by the use of a standardised spreader box system, as exemplified in the Simplex " Monarch " sealing chambers.

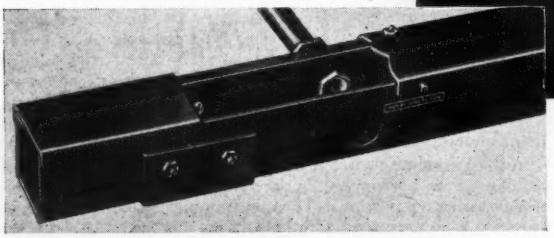
Continuity of production can largely be achieved by the choice of robust and proved designs of equipment and by regular maintenance inspection. Unfortunately, however, it is not possible to eliminate faults entirely, but when faults do occur, the interference with production can be greatly reduced if the circuit protective devices operate in such a way that the faulty circuit only is isolated. This discrimination can be obtained by the use of h.r.c. fuses of correct design. This applies to lighting as well as power circuits.



The inevitable rearrangements and additions to plant focus particular attention on the convenience and flexibility of overhead busbar systems. The new Bill system is shown above with an English Electric scheme on the left

The h.r.c. fuse is admirable for use as a back-up or short-circuit for circuit breakers. In most cases, however, all three fuses in a three-phase circuit must blow before the circuit is entirely disconnected. Thus, if one fuse blows, as may be in the case of a fault from one line to earth, the circuit is maintained *via* the other two lines. No indication is given to an operator that such a condition exists and motors may continue to run as modified single-phase machines, the two healthy lines carrying the whole electrical input of the machine. This leads to overheating of cables and machine windings with consequent risk of breakdown. Moreover, the condition cannot be taken care of by under-voltage releases. The only solution is to trip out the breaker, and this has led to the introduction by Johnson & Phillips of an entirely new h.r.c. fuse, known as the " EETEE/JP " fuse with striker pin tripping device.

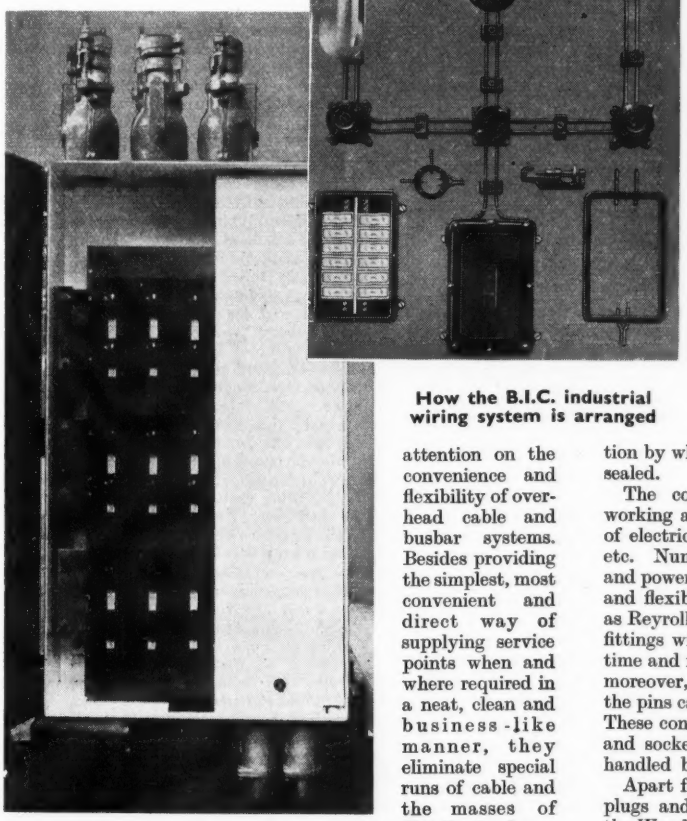
Fuseboards which give particular facilities for quick and easy replacement of h.r.c. cartridges are essential to-day in order to reduce time lost due to fuse blowing. The Donovan 3-way 300-A triple pole and neutral " Scrutact " h.r.c. fuseboard fitted with patent pressure contacts secures this, together with positive and non-deteriorating contacts. Improved insulation also helps to minimise failures, and Interohm Electrical Insulators have produced a material specially suitable for contactor panels, switchboards, boxes and machine parts such as insulators, handles, etc. This material



A popular type of Walsall cable trunking suitable for mounting on girders or brackets fitted to stanchions

is impregnated under high pressure and heat and is baked out between 200 and 250 deg. C. As it is compressed to one ton per sq. in., any possibility is obviated of its giving under the compression of nuts, with the consequent slackening of nuts and resulting bad contacts.

The inevitable rearrangements and additions to plant which are constantly having to be provided for in a growing factory installation focus particular attention on the convenience and flexibility of overhead cable and busbar systems. Besides providing the simplest, most convenient and direct way of supplying service points when and where required in a neat, clean and business-like manner, they eliminate special runs of cable and the masses of distribution boxes scattered on the walls and stanchions.



How the B.I.C. industrial wiring system is arranged

Easy replacement of fuses is a feature of this Donovan 3-way triple-pole and neutral " Scrutact " h.r.c. fuseboard

In the recently introduced Walsall system the cables are carried in ducts provided with frequent knock-outs to facilitate direct lead off to any desired point. New duct extensions are easily and economically made in any direction and extra circuits added to existing ones. The smooth interior of the ducts eliminates any possibility of damage to the cable. If more convenient, the trunking can be supplied for wall or skirting mounting instead of for ceilings.

Jig drilling of the English Electric overhead busbar sections, which are produced in standard 12-ft. lengths, ensures interchangeability and the system can be installed by the contractors without any special fitting on site. Cabling is facilitated by the provision of six-direction cable inlets and three-direction conduit outlets, while the possibility of flashovers on the busbars is eliminated by virtue of the all-insulated construction.

Another overhead busbar chamber system, which Bill Switchgear have just introduced, is being made in standard 8-in. lengths. The cases are arranged to be quickly bolted together and the busbars have flexible connections where required. Detachable covers inserted below the busbar chamber at two-foot intervals permit fuseboxes to be quickly inserted, the fuses in which automatically contact the busbars, thus giving a drop connection below the busbar chamber. The fusebox is arranged with conduit outlets on all sides so that conduits can be taken out in any direction. Two sizes are available, for 200 or 300 A, and three-phase or three-phase and neutral models are also available. The fuseboards can be fitted with either standard Bill arc damping fuses or English Electric h.r.c. cartridges. For a sunk conduit system a Simplex extension box is now available, permitting surface extension, the design allowing an unusually wide choice of angular positions.

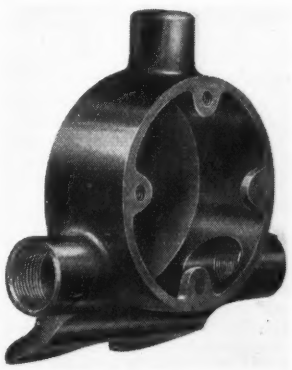
Even if an overhead system of distribution is adopted there are often occasions, especially in the case of portable tools, when the cable connections get in the way of machine operators. This inconvenience and potential source of danger can be avoided by utilising " Wayne " self-winding cable reels supplied by Power House Components who have recently added to their range special units for welding shops and portable tools. For carrying cables round the walls and from the ceilings Electric Depot steel frame insulated cable racks and wrought steel cable hangers are jig drilled to ensure interchangeability. A complete range of these units covers practically all applications but special models can be constructed to meet unusual requirements.

Following the recent memoranda issued by the Electricity Commissioners, the omission of armouring on underground cables will result in a slight saving of time and material in making off the armouring at joints and terminals. Time can be saved, too, by using cold filling compound as made by Henley's, whose universal clamp connectors and sockets have also been designed primarily as an aid to emergency work.

For works in which there is an atmosphere charged with corrosive and destructive gases the B.I. industrial wiring system presents a method of installation by which all conducting parts are permanently hermetically sealed.

The concentrated mass production methods of factories working at war production speed entails the frequent handling of electrical accessories associated with portable electric tools, etc. Numerous socket-outlets are essential to enable lighting and power supplies to be taken to portable devices through plugs and flexible training cables, metalclad plugs and sockets, such as Reyrolle units, have proved very useful. In comparison with fittings without external protective shrouds they save valuable time and money by eliminating the need for replacements, and, moreover, as the contact pins are shielded by the metal casings, the pins cannot be distorted if the plug is inadvertently dropped. These constructional features, which combine to make the plugs and sockets completely reliable, also ensure that they can be handled by unskilled operatives with absolute safety.

Apart from the wide range of ironclad surface and flush type plugs and sockets, including watertight and gastight models, the Wandsworth Electrical Manufacturing Co. has also available a number of " protected " units with recessed switch dollies to guard against accidental damage. In securing a fully protected system of wiring the use of flexible metallic tubing and adapters as supplied by Fitter & Poulter for linking up with conduit will be found of great service.



G.E.C. conduit purlin box

In view of the essential need for speed and economy in erection of electrical installations the G.E.C.'s specially designed conduit purlin box will be found invaluable. It has two fixing lugs for direct mounting to the purlins and carries " through " outlets for screwed 1-in. e.t. and one " tee-off " $\frac{3}{4}$-in. e.t.

With the increasing use of DC for certain industrial processes a useful piece of apparatus now available is the Westinghouse static phase convertor, which can be employed on a single-phase supply for operating a rectifier where the conditions of use make a three-phase rectifier necessary. The apparatus also permits three-phase motors to be run from a single-phase supply.

PERSONAL and SOCIAL

Information regarding new appointments and other matters of interest for this page are welcomed

THE Chester Corporation City Council on the recommendation of the Electricity Committee has decided that **Mr. S. E. Britton,** city electrical engineer, shall be placed on pension from April 11th next and shall be paid, by way of retainer for the continuance of his services, an annual sum equivalent to the difference between his pension and £1,250 per annum.

Mr. C. J. Spencer, M.I.E.E., M.Inst.T., has retired from the position of resident director of the Northmet Power Co. Mr. Spencer, although latterly with the Northmet Company, was a transport engineer and had spent most of his career with various transport undertakings in this country. After serving a pupilage with the Blackpool Electric Tramways Co., he became electrician and assistant engineer with the South Staffordshire Electric Tramways at Walsall. In 1898 he was appointed general manager of the Bradford Corporation tramways where he introduced trolley buses in 1911. His next position was as general manager of the Metropolitan Electric Tramways, the London United Tramways and the South Metropolitan Electric Tramways & Lighting Co., which position he took up in 1918, and in this capacity (in 1931) he commenced the conversion of the London tramways to trolley buses. Upon the establishment of the London Passenger Transport Board in 1933 Mr. Spencer became general manager, tramways, Northern and Western Areas, and in the same year joined the Northmet Co. He has been a member of the Council of the Tramways, Light Railways & Transport Association, a member of the N.J.I.C. for the Tramway Industry, president and former hon. secretary of the Municipal Tramways & Transport Association, a member of the Electric Traction Committee of E.D.A., and a member of the Electrical Interference with Broadcasting Committee of the I.E.E.

Mr. E. W. Faithfull, A.M.I.E.E., consumers' installation engineer, Bridport Corporation Electricity Department, has been appointed power installation engineer to the Wycombe Corporation Electricity Department.

At a recent social gathering of members of the Heston and Isleworth Corporation Electricity Department Mr. S. H. Fowles, the borough electrical engineer, presented a cheque on behalf of the members to **Mr. W. J. Forster,** the deputy electrical engineer, who, as we have already reported, has been appointed to a similar position at Walthamstow. **Mr. R. B. Francis** has been appointed to succeed Mr. Forster at Heston.

Miss Mary F. Kirkup, of the Sunderland Corporation Electricity Supply Department, has been awarded the Elizabeth Sloan Chesser Cup by the Electrical Association for Women. The cup is awarded annually to the demonstrator obtaining the highest number of marks in the practical test for the E.A.W. diploma in electrical housecraft during the year.

St. Pancras Borough Council Electricity Committee reports that its attention has been called to the heroic action of **Mr. G. Mills,** cable ganger, in the removal of a large delayed action bomb which had penetrated a roadway to a considerable depth, adjacent to a main sewer, and in between two nests of h.v. cables which run on either side of the road and which supply a large area in the southern part of the borough. Failure to remove the bomb would have necessitated its being exploded in situ, and the aid Mr. Mills was able to render in its final removal greatly assisted the good work done by the Royal Engineers and probably avoided this drastic course being adopted. As the result of its safe removal, the Council's mains were preserved, and an interruption in the supply to a large area of the borough avoided, and the danger to adjacent property removed.

The Committee has expressed the Council's thanks and commendation of the work accomplished by Mr. Mills, and has awarded him £5.

Mr. G. A. Tottman, station superintendent to the Hammersmith Borough Council Electricity Department, has retired on account of ill-health.

Mr. F. Newey, city electrical engineer, Lincoln, was elected president of Lincoln Engineering Society, in succession to Mr. A. Johnstone, at the meeting held on January 17th, at the Lincoln Technical College.

Mr. J. Pilkington, of Doncaster, has been appointed works manager of the Concordia Electric Safety Lamp Co., Ltd., Cardiff. Mr. Pilkington has for many years held the position of head electrician at Markham Main Colliery, Armthorpe, Doncaster.

Major G. W. Clothier, who is mentioned in dispatches, is an electrical engineer in civil life and son of the late Mr. H. W. Clothier who was a director of A. Reyrolle & Co., Ltd. When war broke out Major Clothier held the rank of captain and commanded the Gateshead Field Company of the Royal Engineers (T.A.).

Mr. T. A. Macauley has requested the board of A. C. Cossor, Ltd., to accept his resignation as chairman owing to demands on his time for work of national importance, and he has nominated **Sir Louis Sterling** to succeed him. Mr. Macauley has consented to act as vice-chairman and chairman of the Finance Committee.

Tiverton (Devon) Town Council has decided to appoint **Mr. H. T. Corrigan** as manager of the borough electricity undertaking at a salary of £400 per annum, in succession to his father, **Mr. C. W. E. Corrigan,** who has recently resigned from that position after several years' service. Mr. H. T. Corrigan has previously held the appointment of assistant electrical engineer.

The General Committee of the Diesel Engine Users' Association has awarded the Percy Still Medal for 1939-40 to **Messrs. T. Hornbuckle** and **A. K. Bruce** for their paper, "Herbert Akroyd Stuart and the Development of Heavy Oil Engines."

Obituary

Mr. Alfred Dickinson, formerly principal of Alfred Dickinson & Co., consulting engineers of London and Birmingham, died last week at his home at Rhyl. He was eighty-five years of age. Mr. Dickinson was apprenticed in the engineer's office at London Road, Manchester, of the Sheffield, Manchester and Lincolnshire Railway, and in 1892 he started in business on his own account as consulting engineer in Birmingham and London. He was one of the first engineers to construct electric tramways with overhead lines in Great Britain and became general manager of South Staffordshire Tramways and consulting engineer to the Birmingham Corporation Tramways. He carried out engineering work in almost every country in the world, and built and equipped tramways in Barcelona, Madrid, Cape Town, Hong Kong, Singapore and Dublin. Mr. Dickinson made numerous voyages to Japan, China, India, South Africa and the United States, and acted as engineer to the Tata hydro-electric undertaking in India. He was consulting engineer for the Tasmanian Government hydro-electric schemes and was well known as a Parliamentary and expert witness in matters relating to electrical undertakings. He took out many patents and formed a company under the title of "Dickinson Patents, Ltd." Mr. Dickinson was a member of the Institutions of Civil, Electrical and Mechanical Engineers.

Prof. Miles Walker.—It is with deep regret that we have to record the death of Prof. Miles Walker, which occurred on January 22nd, at the age of seventy-three years. Prof. Walker was educated for the law and qualified as a solicitor. He was, however, anxious to take up engineering as a career and he abandoned law, going to the Finsbury Technical College as a pupil and assistant of Prof. Silvanus Thompson. From Finsbury he went to St. John's College, Cambridge, where he took first-class honours in the Natural Sciences Tripos in 1898, and in the Mechanical Sciences Tripos in the following year. He joined the Westinghouse Company of America in 1900 and spent three years in the company's shops in Pittsburgh. On returning to this country he went to Trafford Park as designer of AC machinery to the British Westinghouse Co., with whom he designed improvements in rotary convertors and other electrical machines. When the chair of electrical engineering at Manchester University became vacant in 1912 Prof. Walker was appointed to this position which he held until 1932, retiring as Professor Emeritus. He did not, however, give up his work entirely and for a number of years continued as examiner for various universities. He was a Fellow of the Royal Society, D.Sc.(Lond.), M.A. (Cantab.), and a member of the Institution of Electrical Engineers, and was the author of many papers on electrical machinery presented to the last-mentioned Institution. He was also the author of a number of books, including "The Diagnosing and Cure of Troubles in Electrical Machinery." Prof. Walker was president of the Engineering Section of the British Association in 1932, and he was a keen supporter of the M.K.S. system of units.

The late Prof. Miles Walker

Mr. G. E. Gittins.—We regret to report the death of Mr. G. E. Gittins, B.Sc. (Lond.), M.I.E.E., on January 16th. Mr. Gittins was born at Tunstall, Staffordshire, in 1871, and received his early training at the Wedgewood Institute, Hanley, afterwards proceeding to Chester College. He was a lecturer in electrical engineering at Blackburn Technical College from 1899 until 1903, when he became head of the Electrical Engineering Department of the Harris Institute, Preston, which post he held until 1917. Whilst at Preston and during the last war, he undertook voluntary work with the Southport and Preston Electricity Departments.

In 1917 he joined the British Westinghouse Electrical and Manufacturing Co. (now Metropolitan-Vickers Electrical Co., Ltd.), taking up a position in the Switchgear Engineering Department. He also took up lecturing at the Manchester College of Technology. In 1923 he was appointed sales manager of the Transformer Department, which position he held until his death.

He was an active member of the Association of Mining Electrical Engineers and was president of the North-Western Branch in 1927-28 and, until recently, convener of the Examinations Committee of the Association.

Mr. George J. Wright, who for nearly thirty years was resident electrical engineer at Elemore Colliery, co. Durham, died recently at Hetton.

Mr. I. S. Mackenzie.—In our last issue we briefly announced the death of Mr. Ian Scott Mackenzie, M.I.E.E., M.A.M.E.E., M.I.F., which occurred on January 18th, in his sixtieth year. Mr. Mackenzie received his technical education at the Central Technical College, South Kensington, and his practical training at the Earl of Dudley's Round Oak Iron & Steel Works, Brierley Hill, Staffs. His first appointment was with Burn & Co., in Calcutta, whom he joined in 1902 as assistant engineer, and in the following year he took up a similar appointment in the Public Works Department, India. In 1908 he was appointed chief assistant engineer to the Madras Electric Supply Corporation and he held this position until the outbreak of the last war. From 1914-18 he saw war service in India, and in the latter year returned to England to take up an appointment as chief assistant engineer with the Newcastle-upon-Tyne Electric Supply Co., Ltd. (now the North-Eastern Electric Supply Co., Ltd.). Mr. Mackenzie joined the Staveley Coal & Iron Co., Ltd., as chief electrical engineer in 1921 and remained with that company until 1934 when he became consulting engineer to William Cary & Son, Ltd., a position which he held up to the time of his death.

The late Mr. I. Scott Mackenzie

Mr. C. Bertram.—We regret to learn of the death of Mr. C. Bertram, A.M.I.E.E., who retired on April 30th, 1939, after thirty-one years' service as branch manager at Newcastle-on-Tyne for W. T. Henley's Telegraph Works Co., Ltd. Mr. Bertram served an apprenticeship with Clarke, Chapman & Parsons at Heaton, later joining the staff of the Newcastle & District Electric Lighting Co., Ltd. He subsequently joined the staff of D. Selby Bigge & Co. and was responsible for the first electric power installations in the collieries of Co. Durham.

Mr. G. W. Barras.—Mr. George William Barras, manager of the Leamington Glass Works, Ltd., which is associated with the G.E.C., has died at the age of seventy-seven. Mr. Barras was concerned with his father in producing the first bulb for Joseph Swan's filament lamps.

Will.—The late **Mr. Isaac H. Parsons,** managing director of Gent & Co., Ltd., left estate valued at £58,216 (£56,167 net personalty).

Power Engineers' Salaries

Taxation Excluded from Calculations

AS we reported in our last week's issue, the National Joint Board of Employers and Members of Staff (Electricity Supply Industry) have issued a revised table of salaries for power station staffs to take effect from January 1st. In this revision the effect of increased taxation upon the cost of living has been ignored.

The new salaries are shown in the accompanying table. The letters appearing in each class indicate (a) the salary for the first two years of service; (b) for the next two years; and (c) after four years' service. Certain of the grades bear definite descriptions :—Grade 1 is deputy chief official; Grade 3 is power station superintendent or mains superintendent (with charge of substations); Grade 4 is mains superintendent (without charge of substations); Grade 8 is shift charge engineer; Grade 8b is substation charge engineer; and Grade 9a is switchboard attendant.

Employees in the London area are entitled to an additional 5 per cent. on the stated salaries, and in any district where conditions justify lower remuneration a reduction of 5 per cent. in the rates can be made by agreement.

SCHEDULE OF SALARIES

(Capacity or maximum demand in kW.)

Grade		1	2	3	4	5	6	7	8	8a	8b	9	9a	10	10a	10b	10c	11	11a	11b
		£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Class A 1,000-2,000	a	504	439	396	341	323	293	266	266	247	228	—	—	—	—	—	—	—	—	—
	b	516	449	405	353	332	304	275	270	250	231	—	—	—	—	—	—	—	—	—
	c	528	460	415	365	339	314	284	275	254	235	—	—	—	—	—	—	—	—	—
Class B 2,001-4,000	a	540	469	423	377	348	325	293	280	258	238	—	—	—	—	—	—	—	—	—
	b	556	484	437	384	359	332	304	285	262	241	—	—	—	—	—	—	—	—	—
	c	573	499	452	393	370	339	314	289	266	245	—	—	—	—	—	—	—	—	—
Class C 4,001-6,000	a	589	513	465	401	380	346	325	293	270	249	228	—	—	—	—	—	—	—	—
	b	600	523	473	413	387	356	331	302	278	256	234	—	—	—	—	—	—	—	—
	c	610	532	482	425	395	367	335	311	286	262	239	—	—	—	—	—	—	—	—
Class D 6,001-8,000	a	621	542	490	437	402	377	341	320	293	268	245	228	—	—	—	—	—	—	—
	b	635	556	503	449	413	382	350	325	299	274	251	234	—	—	—	—	—	—	—
	c	650	570	516	460	422	389	360	331	305	281	257	240	—	—	—	—	—	—	—
Class E 8,001-13,000	a	—	585	530	471	433	395	369	335	311	287	264	246	228	—	—	—	—	—	—
	b	—	599	537	478	444	405	377	344	319	294	270	249	230	—	—	—	—	—	—
	c	—	614	544	484	456	416	387	353	328	302	278	252	232	—	—	—	—	—	—
Class F 13,001-25,000	a	—	—	550	491	466	425	396	362	335	310	285	256	235	—	—	—	—	—	—
	b	—	—	563	507	472	435	401	370	343	317	292	261	237	—	—	—	—	—	—
	c	—	—	577	524	479	444	406	377	350	324	297	266	238	—	—	—	—	—	—
Class G 25,001-50,000	a	—	—	589	541	485	454	411	385	358	331	304	271	241	228	—	—	—	—	—
	b	—	—	604	552	501	463	424	390	363	336	311	278	247	234	—	—	—	—	—
	c	—	—	619	564	515	473	438	394	369	343	318	284	252	239	—	—	—	—	—
Class H 50,001-100,000	a	—	—	633	576	531	483	452	399	374	349	325	291	257	245	228	—	—	—	—
	b	—	—	654	590	541	498	460	411	384	358	332	298	265	251	234	—	—	—	—
	c	—	—	674	606	551	512	468	423	394	367	339	305	273	257	239	—	—	—	—
Class J 100,001-150,000	a	—	—	694	621	561	527	476	435	405	376	346	313	281	263	245	228	—	—	—
	b	—	—	712	636	576	541	489	447	416	385	355	322	289	269	251	234	—	—	—
	c	—	—	729	653	590	554	501	458	426	395	365	330	295	277	257	240	—	—	—
Class K 150,001-200,000	a	—	—	748	669	605	568	513	469	437	405	374	338	303	284	263	246	228	—	—
	b	—	—	767	686	621	583	527	482	449	416	383	347	311	292	269	252	234	—	—
	c	—	—	786	703	636	597	540	494	460	426	393	356	320	299	277	258	240	—	—
Class L 200,001-250,000	a	—	—	805	720	652	612	553	506	471	437	403	366	328	306	284	264	246	228	—
	b	—	—	826	739	669	628	568	519	484	449	414	376	336	314	292	270	252	234	—
	c	—	—	846	757	685	643	582	533	496	460	424	385	345	323	299	278	258	240	—
Class M Over 250,000		—	—	867	776	703	660	596	545	508	471	435	395	354	331	306	285	264	246	228

Electrical Research

The work of the "E.R.A." in 1940

DURING the past full year of war many manufacturing and electricity supply organisations have had to concentrate almost all their energies upon requirements immediately connected with the fighting services. This has reduced their individual research activities, leaving its maintenance in the common interest to the Electrical Research Association.

How the Association, of which Mr. E. B. Wedmore is director and secretary, has managed to preserve continuity in the more urgent instances and, at the same time, establish a working liaison with Government Departments contributing directly to the war effort is indicated in its annual report for 1940. Some adjustments in procedure and programmes, previously foreshadowed, had to be effected and circumstances have necessitated a considerable reduction of committee meetings; but technical collaboration and financial support from the Dominions and Colonies have continued unabated.

Apart from a reduction occasioned by the fact that the Government grant in aid had been more difficult to earn, the income from all principal sources is being well maintained. The scale of expenditure is substantially unaltered, if allowance be made for a smaller contribution to reserve from the year's revenue, but the balance sheet shows also substantial additions to the assets, involving inroads on available funds.

Despite the handicap of war conditions the Electrical Research Association has made progress in many departments of its useful work on behalf of the industry

The first portion of the projected extension of the laboratory was completed during the year; materials were fortunately secured at favourable prices. The design of another wing of the new building is receiving attention, pending an opportune time for its erection; it should incorporate an enlarged high-voltage section and afford better facilities for impulse testing. The information bureau is proving to be of increasing value and importance. To assist those requiring, or planning, research, a statement has been prepared (ref.: ERA/T306) detailing the special facilities available to the E.R.A., especially the laboratory equipment, which is unique in many ways, particularly in respect of portability for field work.

The newly set up Section K—Electricity Supply Technology, will concern itself with the study of generation and sale aspects as distinct from the design and utilisation of plant. Another recently established section, Y, will correlate and expand the Association's activities in the important heating and cooking spheres. In his foreword to the report Mr. C. W. Marshall, chairman of the Council, announces that a compendium of information on surge phenomena will soon be published (in book form) and refers also to the introduction of a commercial model of the E.R.A.-type surge filter for protecting equipment against damage due to lightning.

Further efforts are being made to trace the source and magnitude of the voltage that causes surface sparking on structures when switchgear is operated. Insulating glands at the termination of single-core lead-sheathed cables, that is, at the entry to busbar chambers of circuit-breakers (a point at which sparking frequently takes place, even when the cable sheaths are well earthed near the gland) may be eliminated if the cables are paralleled by suitable auxiliary earthing conductors. A novel method of analysing fuse performance has been devised, which has made possible a more systematic treatment of certain aspects than hitherto.

Further information has been acquired about improved cements of the calcium-sulphate class for fixing glass inserts in flameproof gear for coal mines. It is believed that the worst conditions under which pressure piling can occur in a commercial type motor casing have been determined and further test evidence has been provided to enable the British Standards Institution to establish a "safe" gap between flanges in oil-immersed mining gear. Also the ascertainment of maximum experimental safe gaps in the case of flanged gear needing to be flameproof in industrial use has been actively pursued. Work on the properties of steam is nearing completion, but when conditions permit it may be desirable to extend the range.

Work long since overdue on magnetic materials has been extended. That portion conducted under Prof. W. L. Bragg at Cambridge University has been continued on those alloy systems containing elements which are likely to prove of importance in the production of permanent magnets. At first sight it may seem that certain of these systems cannot be of great significance, but they are nevertheless needed in order completely to define the functions of those elements which appear in small quantities in commercial alloys.

For example the alloys FePt and CoPt, which have a higher coercive force than "Alnico," although they are too expensive to be of commercial importance, might throw some light on the nature of the causes of high coercive force. The experiments have proved most valuable in showing how the high coercive state can be recognised both by X-rays and by the microscope, and also in providing support for Bradleys laminar theory proposed for the alloy Cu_4FeNi_3. Specimens of the new permanent magnet alloys, "Ticonal" and "Alxomax," have been examined to see if the use of X-rays can be made to contribute to an understanding of their remarkable properties.

The research under Professor W. Sucksmith represents an extension of the magnetic study of the two-phase iron-nickel alloys, with the object of extending the equilibrium phase diagram of the iron-rich alloys towards lower temperatures.

The Association has continued to co-operate with the Permanent Magnets Association in research of industrial interest. Experiments have been carried out to find the effect of a mechanical load, applied during cooling from the heat treatment temperature, on the magnetic properties of "Alnico." Cooling in a magnetic field led to the production of the new alloy "Ticonal," possessing such exceptional magnetic properties in the direction of the magnetic length. A report on the properties of permanent magnet materials formed from crushed alloys has been issued to members.

Useful progress has been made in the scientific study of plasticity and brittleness, and under war conditions manufacturers are leaning heavily on the E.R.A. in the study of dielectric selection and use. New commercial materials such as cellulose derivative films, fine glass fibres and new moulded products are being critically studied in close co-operation with the interested manufacturers and users, and at the same time important long-range work is being continued in several directions.

Excellent progress has been made in high-frequency technique and considerable assistance given to manufacturers, although unfortunately the manufacturers of radio apparatus have not been able to participate to the extent hoped for. On the outbreak of war the British Standards Institution decided not to proceed with licences for the use of the B.S.I. mark for appliances made incapable of interfering with radio reception. Nevertheless, certain specifications in course of production or revision were completed, such as those dealing with components, ignition systems, radio receivers and marine installations.

Study of the h.f. properties of small machines has demonstrated the advantage of high impedance and the consequent influence on interference of the design of the windings and number of commutator segments.

A thermal method for the measurement of the resistance of short specimens of wire in the 100/600 Mc/s frequency range has been developed and includes a new u.h.f. ammeter. The method has been applied to the measurement of skin effect in wires and the effective permeability of ferromagnetic wires at ultra-high frequencies has been deduced therefrom. It has been shown that it is possible to make ferromagnetic conductors which possess high impedance.

In view of the importance of ignition phenomena, work on the capacity spark which was temporarily suspended has been resumed, and it has been found possible to obtain a stationary figure on a recurrent surge oscillograph.

Control Equipment

Speeding-up Workshop Production

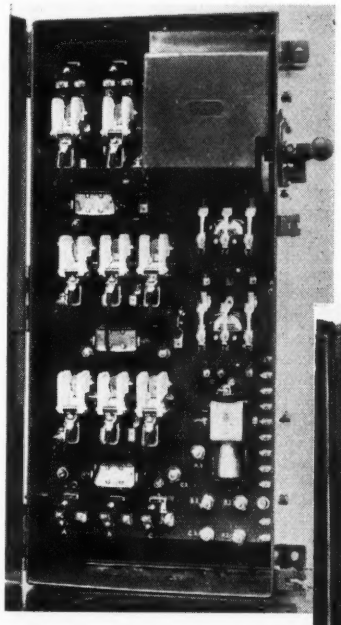
With the increasing use of semi-skilled operators simplicity of control of electrically-driven machinery assumes a greater importance than ever before

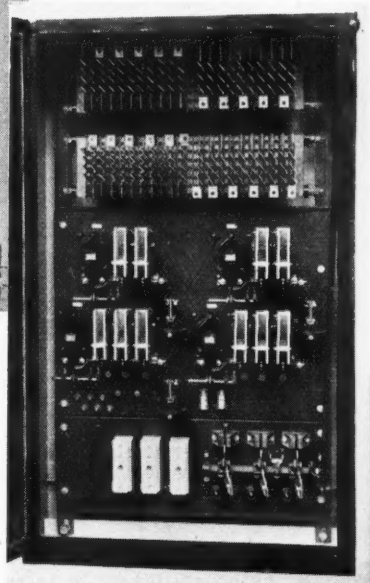
IN the present drive for increased output the matter of accelerating shop production has been thoroughly explored and in many cases control equipment has been designed to contribute very effectively to this end, particularly in regard to machine tool technique. The control of machine tools and other industrial drives falls broadly into two types, viz., hand operated and automatic contactor gear. All starting and control gear should be chosen with conservatively rated contacts and connections so as to ensure continuous operation without frequent maintenance, and should also embody fully automatic trips against overloads and failure of voltage so as to ensure working the machines to the maximum capacity without danger of breakdown.

Many applications exist for simple hand-operated types of starters, which in the case of individual motor drive can be mounted adjacent to the machine and thus provide the operator with complete control of the driving power. For some of the more specialised types of machine tools involving several driving motors it is usually more convenient, however, to use contactor type control gear as this enables the control switches to be centralised at a point convenient to the operator, namely, a multiple point push-button station mounted on the machine or suspended in pendant fashion. A typical example of this is to be found in a Metrovick contactor starting gear for controlling a Coventry Gauge Company's thread grinding machine, which has four driving motors. Some of these motors are of the DC type with a wide speed range, this being accomplished by the use of Ward-Leonard control. The Ward-Leonard generator set, together with the contactor gear, is housed in a cupboard type enclosure which also serves as a work bench. The control switches and the speed-regulating rheostats are mounted on the end of the cupboard which is located alongside the grinding machine. Thus the operator has convenient and complete control of the various driving motions, while the simplicity of the push-button control enables him to devote practically all his attention to the work on the machine.

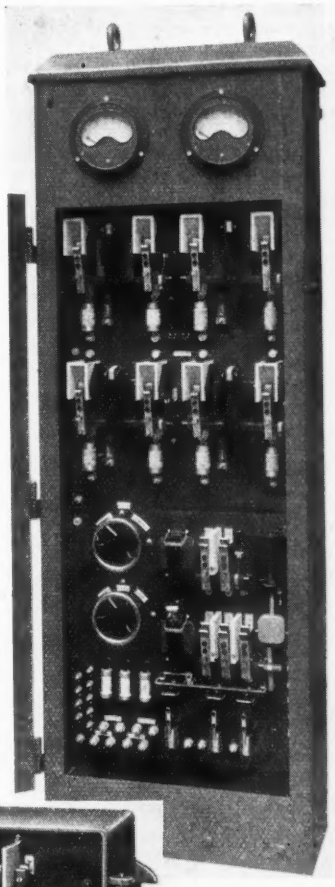
The simplicity of electrical control is, in fact, perhaps its most striking and, at present in particular, its most important feature. With more and more unskilled operators being brought into service, manufacturers are paying special attention to this point, as well as to providing even better protective features. "Mistake-proof" is the epithet applied by the G.E.C. to its range of starters and control gear, while the Morecambe Electrical Equipment Co. tells us that all its gear is now designed for mass production use and it is concentrating on simple straightforward standard lines which will permit quicker and better service. This equipment is particularly easy to erect and maintain, and specially large margins of safety, both mechanically and electrically, should enable it to stand up to all war service conditions. Magnetic overloads are fitted to the whole range of products.

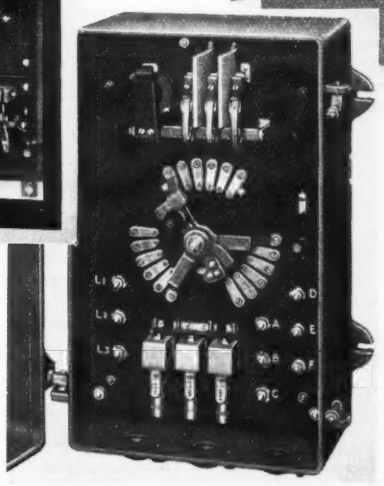
For the same purpose various Statter products, including oil-immersed ironclad star-delta starters and oil switches, have been specially designed with a view to mass production. Apart from the other features mentioned, this has the further advantage of permitting a low price to be charged for the equipment





A Donovan composite panel for a milling machine shown above. Right: Igranic 70-HP, 440-V type "1080" stator and rotor starter incorporating "Service" resistances





A control panel designed by Milne & Longbottom for 24-hour a day service in a bronze foundry and (left) a Morecambe "MASR 35" air-break stator rotor starter

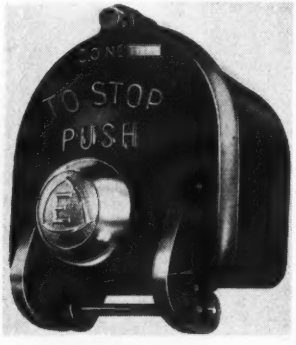
without having to dispense with any of the modern refinements.

High-speed production on machine tools by semi-skilled labour can be much more rapidly achieved if fully automatic control gear is provided. A typical instance is furnished by a Donovan composite panel for use on an individually driven and motorised milling machine. This comprises an interlocked isolating switch, contactor star-delta starter for the 20-HP main motor and a small direct switching contactor reversing elevator motor starter. The whole apparatus is controlled by push-buttons grouped conveniently for the operator. How a single composite piece of apparatus taking the place of three separate units greatly simplifies wiring is demonstrated by another Donovan product, an AC direct-switching starter with interlocked isolator, push-buttons in the lid and a built-in low-voltage transformer for local lighting.

To mention just one of the precautions taken by George Ellison, Ltd., to prevent unnecessary shutdowns, its starters for squirrel-cage motors and the control panels for slip-ring motors are fitted with solenoid overload releases with time lags. The mechanism of these releases is designed so that overloads of short duration pass without interrupting the circuit, while dangerous or persistent overloads trip the starter before damage is done to the motor or plant.

While referring to Ellison gear, there are two items of special utility for present use. One is a " works tidy," a locker stand on which can be mounted circuit breakers and starters of up to 100 A. Besides accommodating the machine spares, the cupboard will also hold the personal belongings of the operator. This accessory has been found of great assistance in maintaining the orderly appearance of the machine tool shop—a factor which helps to meet the present demand for increased output.

The other Ellison item is a range of emergency switches designed to stop motors at a distance. These switches, which can be arranged to close trip coil circuits on circuit-breakers or motor starters, or to open the no-volt release coil circuits, are of the greatest value when it is necessary to stop electrically driven machinery during air-raids. They can be connected together for operation by individual machine operators, or housed together at a central control point. Similar emergency switches are also marketed by the G.E.C.



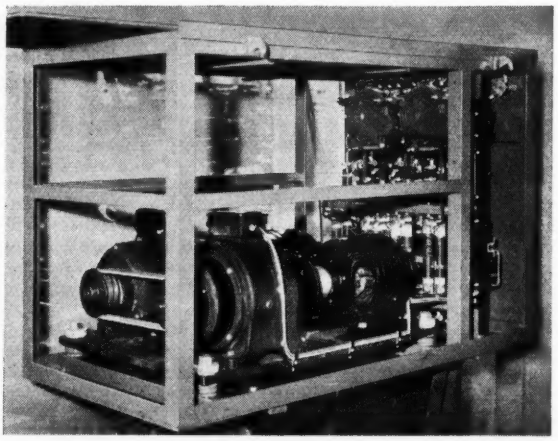
Ellison emergency push-button especially useful for stopping electrically driven machinery during air-raids

Although producing many standard types of push-button starter, Milne & Longbottom tell us that they have found by experience that, for the motorisation of machine tools, co-operation between the machine tool designers and the switchgear manufacturers leads to maximum efficiency and speed. Any motorised machine in which several motors are employed calls for carefully planned control gear: it is preferable that such control gear should be part of the machine and the position of the control station should be carefully thought out to give efficiency to the operator.

On some of the latest designs of switchgear they have dispensed with the usual finger operated push-button station and have substituted a foot control fitted into a part of the machine or in some convenient position adjoining. This method of control allows the operator to use both hands on his work all the time. On heavy-duty high-speed machine tools it is sometimes necessary to stop work quickly. On smaller machines this braking or stopping may be effected by employing a reversing switch or contactor to pull up the motor quickly. On larger machines, however, employing slip-ring motors of from, say, 20 to 50 HP, this direct reverser method is not satisfactory owing to the very large current taken at the moment of reversing.

Having to face problems of this kind the company has designed special control gear consisting of the usual automatic stator rotor starter, but incorporating provision for braking and stopping by means of injecting a rectified DC into the stator windings. By this means it is possible to stop dead a cutter motor under load within two seconds, as compared with about two minutes without braking. The panels are fully automatic and, with the machines operating twenty-four hours a day, show a substantial gain in actual working hours.

One of the limiting factors in the use of the squirrel-cage type motor is the difficulty of starting against load without taking a heavy current from the mains. The complete range of Electric Construction starters for this type of motor is now fitted with a



Metrovick Ward-Leonard control equipment for a thread grinder

device which, when the motor is connected to the line, by-passes the overload releases until the motor has accelerated to full speed. In addition to its principle function this device makes possible a sensitive setting of the overload releases giving full protection for the motors when running. Star-delta starting of pole-changing type motors is possible with a contactor panel of the latest Brook chassis mounting type, which is complete with triple pole fuses and isolator.

The high level of reliability reached by modern control gear has been enhanced by the development of rustless and unbreakable resistances. The increasing use of these is due to the demands of maintenance engineers who cannot afford to bear the constant risk of breakdown which attends the use of fragile cast-iron and wire resistances. The Rheostatic Co.'s " Service " resistance bank is unbreakable, rigid, rustless and continuous. The grids are pressed from rolled material and every turn of each grid is adequately supported, the construction being such that adjacent grids and adjacent turns of grids cannot vibrate together. No insulating materials other than mica and micanite are used, and all ferrous components have their surfaces alloyed with zinc.

Remote control, of small appliances as well as large, saves a very considerable amount of time. Not only motors, but lamp circuits, electromagnetically operated valves, etc., can be controlled from a distance by means of a push-button. A new Londex two-step relay which can be employed for the purpose greatly facilitates wiring. To leave both of the operator's hands free, foot regulators, such as the Scientific Engineering Co. makes, are useful for certain machines, while for limiting the motion of cranes, hoists, emergency stop systems, etc., limit switches as marketed by the Dalyte Electrical Co. can be called into service.

Temporary dislocations of supply due to enemy action are liable to render voltage fluctuations more frequent and severe. In many of the more intricate industrial processes this may have a very serious effect on the quality of the product. Of particular importance, therefore, is a new construction introduced by Ferranti for greatly increasing the speed of operation of its moving-coil voltage regulator so as to approach more nearly to the ideal of instantaneous control. The company has built a large number of voltage regulators in which a sudden change of 4 per cent. in voltage due to the switching on or off of load is automatically corrected in less than 0.65 second.

Power factor improvement is another problem which must eventually face every industrial consumer of any magnitude. The methods adopted vary according to circumstances, but in the majority of cases static condensers provide the best solution. For controlling the number of condensers in circuit the B.I. system of automatic control provides a most useful service.

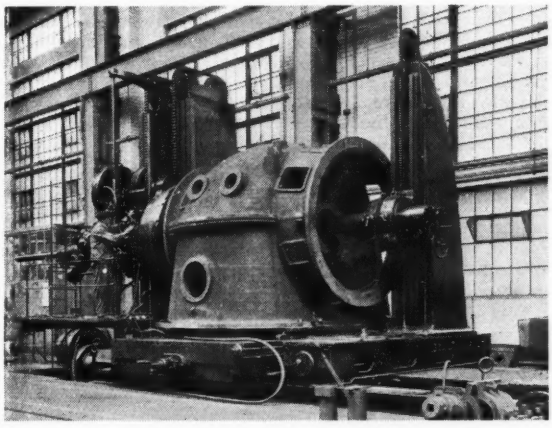
Direct Current

Its Continuing Use in Industry

By D. B. Hoseason, M.I.E.E., M.I.Mech.E.

The author, who is on the board of the Brush Electrical Engineering Co., Ltd., shows that, after years of comparative neglect, the DC motor is returning to favour

SINCE the invention of the induction motor by Nikola Tesla in 1888, the battle of direct *versus* alternating current has continued unabated in this country although, with the introduction of the grid in 1926, many engineers felt that the final blow to DC had been delivered. Distribution systems were changed over to AC and the resulting bias in favour of AC motors undoubtedly influenced many users. Nevertheless, although the use of DC machines as a motive power in industry decreased for some five or six years, the last six or eight years have seen a recovery of the position, and



Horizontal boring machine with variable-speed DC driving motor

to-day the DC machine appears to be as popular as ever, in spite of the dice being loaded against it.

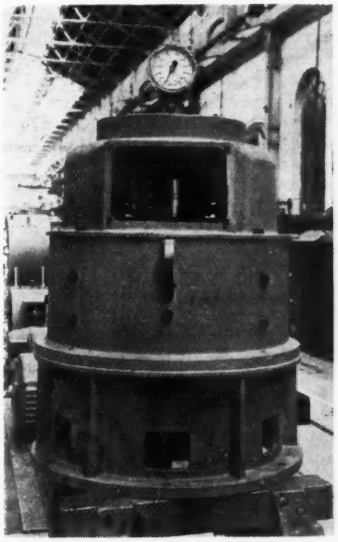
At the time of the introduction of alternating current, towards the end of the last century, the DC machine had been in use for 30 or 40 years and, as is usual, popular attention soon transferred itself to the newer alternating current which offered an easier field for investigation, since very little was known of it. From the beginning of the present century less and less has been spent on development and research on DC machinery and apparatus, with the result that, although some 30 or 40 years older than its AC counterpart, the DC machine is probably less highly developed. Anticipating that DC would finally disappear, manufacturers have contented themselves with minor improvements to their ranges of DC machinery, while, during the same period, two and even three entirely new lines of AC motors have been put on the market. During the last few years, however, many manufacturers have recorded a steady increase in the value of orders for DC plant when compared with AC, and it is evident that public opinion is once more changing in favour of the use of direct current for many drives in industry.

It has been customary in the past to classify most electric motor drives as either constant- or variable-speed. There are, however, four main groups :—

1. *Fixed Constant Speed.* Group drive of line shafts, constant head pumps and similar drives come into this classification and the squirrel-cage motor is undoubtedly the best form of motive power.
2. *Adjustable Constant Speed.* Colliery fans and pumps where the required fan water gauge or pump head may vary are in this category, and shunt AC commutator motors or adjustable speed shunt DC motors are usually employed.
3. *Manipulative Variable Speed.* Cranes, elevators, winches and similar applications fall in this category, and there is no doubt that the direct-current series motor is the best type of machine for this duty.
4. *Co-ordinated Speed Control.* The sectional drive of papermaking machines, certain operations in the chemical industry, and the more recently developed boiler house auxiliary drives come under this heading. Here the DC machine undoubtedly leads the field for simplicity combined with reliability.

The more intensive electrification of industry had its beginning in the early years of the present century and since then engineers have naturally concentrated on electrifying the easy drives. The 1930 Census of Production of the Board of Trade showed that British industry was only some 55 per cent. electrified. This electrification, having been concentrated on the constant speed or more straightforward types of industrial drive, gave considerable scope to the induction motor. Now that we are approaching the more complex and difficult operations, however, it is doubtful whether this type of machine is the most suitable. In addition to the fact that we are now entering a phase in which electricity is applied to the more difficult industrial drives, modern processes are becoming more involved, and the designers of machine tools, textile machinery and other productive equipment are calling for something more than the simple constant-speed squirrel-cage motor from the electrical engineer.

It is claimed that one of the outstanding advantages of electrical drive when compared with other forms of motive power is the ease of control ; yet, when a squirrel-cage motor with a mechanical gear box is installed to obtain speed variation, there is no real exploitation of the adaptability of electric drive. There is always a tendency to install the cheapest form of drive rather than that which is economically the soundest, but possibly of greater first cost, and this has often led to the use of the squirrel - cage motor without full consideration of more suitable alternatives. It is quite possible that the exploitation of electric drive in industry would have been much further advanced if the cheap and simple squirrel-cage motor had not been invented, and engineers had been forced to develop the DC machine to its full possibilities.



Typical modern variable-speed DC pump with tachometer

Manual work is being slowly eliminated from industrial methods, and whether in the steel industry, chemicals or paper making, the various processes are being linked together so that the product of one type of machine feeds direct into another. The reason for this is that machinery will usually carry out an operation at least five times as fast as it can be done manually, and the rate of production of many installations is determined largely by the rate at which the plant can be fed by the operators. Wherever a product has to be transferred from one machine to another it is found that delays occur, and a substantial speed-up can be achieved by the mechanisation of the feed from one operation to the next. An example of this is the continuous

mill used for making sheet steel, and co-ordinated speed control is essential in all these cases.

In the type of drive described in the preceding paragraph, the raw material progresses in a series flow from one machine to the next and co-ordinated speed control of the driving motors is necessary to ensure that the speeds of the individual operations can be set accurately and at the same time the speed of the entire line of production can be raised or lowered at will. Another type of drive also occurs calling for co-ordinated speed control, in which several different raw materials flow in parallel, being finally assembled or brought together to form the finished product. Examples of this occur in the chemical industry.

Another instance is the boiler house in which coal, air and water are fed into the boiler to produce the steam. The practice in the past has been to vary the supplies of coal, air and feed water by individual adjustment. It is obvious, however, that a higher standard of overall efficiency can be maintained by using to the full the ease of control of the electric drive and introducing a system of co-ordinated control.

High Production Rates

In the cost of all products there are three main constituents, labour, material and overhead charges, and the general effect of the increased mechanisation of industry is to reduce labour costs and increase the proportion of overheads. A considerable portion of the overhead charges of a factory is accounted for by rents, rates, taxes, heating, lighting, etc., and does not vary with the volume of work. This means that there are substantial economic advantages to be gained from the use of machinery with high rates of production and if the nature of the work varies, calling for changes in speed, the equipment should be capable of adjustment so that the last ounce of output can be obtained from the plant.

Electrical power is usually classed in overheads and is, in fact, a very small proportion of the total cost of production, probably less than 5 per cent. in many cases. The efficiency of the DC machine is rarely as high as that of the simple AC squirrel-cage motor, but since the cost of power is such a small item in the total cost of production, any variation in actual motor efficiency even of the order of 5 or 10 per cent., is a matter of secondary importance. This feature is undoubtedly influencing many engineers in favour of direct-current motors for industrial drives. The induction motor with its limited maximum speed, with or without a gear box having fixed steppings, is a constant limitation on obtaining the last 5 per cent. from the plant.

In machine shops, the principal need for DC arises with the variable speed required to secure constant rate of cutting on parts of varying diameter. On such tools as wheel lathes and boring mills, as the tool progresses from the larger diameters to the smaller, the revolutions per minute of the work should be increased. This can readily be achieved by equipping the machine tool with a simple variable-speed shunt-wound DC motor, and in the majority of general-purpose machine shops, there will nearly always be found a number of these drives.

If the installation is more than about 500 kW, it will usually be found desirable to run a DC circuit in addition to the normal AC supply, and conversion will be most economically carried out by the use of mercury-arc rectifiers on a 50-cycle supply, but on 25 cycles rotary convertors may be economical. If the speed variation necessitated by the drive exceeds some 5 or 6 to 1, or if rapid changes in speed are required such as occur on a planing machine, it will usually be found advantageous to adopt the Ward-Leonard system with a motor-generator set operating off the AC supply and feeding the actual motor driving the tool.

In the case of co-ordinated speed control motor generators are almost essential, and in most instances are arranged to feed one or more of the actual driving motors, as, for example, in the DC boiler house drive. In this drive each of the boilers in a particular bank is provided with a motor-generator set feeding the armatures of the induced- and forced-draught fans, and the stoker motors. The boiler feed pump motor may also be supplied from the motor generator set. The fields of the various motors are separately excited from a constant voltage, and by means of the rheostats the relative speeds of the motors can be adjusted.

If it is desired to increase the rate of steaming of any particular boiler, this is done by raising the voltage on its appropriate motor-generator set and so bringing up simultaneously the speeds of all the motors on that particular boiler. The DC generators of all the motor-generator sets in the bank of boilers have their fields supplied from a small separate exciter set, and if it is desired to increase the rate of steaming for the entire bank, this is done by raising the voltage on the exciter set. The very minimum of switch and control gear is involved in this scheme and all the various units are simple well-tried pieces of apparatus. In an emergency, the co-ordinated control can be ignored and the individual drives operated separately.

Simplicity of Control

The DC machine is, to the user, a relatively simple piece of equipment and the various methods of controlling it are readily understood by maintenance engineers and electricians. The different characteristics that are required for such varied drives as cranes, planers or boiler houses with co-ordinated speed control involve no fundamental special features in the design of the motors, but are achieved by various arrangements of the field circuits and rheostats. This simplicity is a great advantage to the user.

To the manufacturer, on the other hand, the construction of DC machines is a far more involved process than that of the corresponding induction motors. Few major design changes have been made during the past 25 years and there is considerable scope for development. For example, the commutator and brushgear of a DC machine account for a considerable portion of the total cost and it does not seem reasonable that these parts should be operated at current densities as low as 50/100 A per sq. in. when the conductors of most other electrical apparatus operate at densities over 1,000 A per sq. in. There is already indication that development activity will lead to improvements in design, and the effect of these advances should be to improve still further the case for DC when compared with AC motors.

KENT ELECTRIC POWER BILL

MEETINGS of the Kent Electric Power Co. and its associated concerns—West Kent Electric Co., Ltd., and the South-East Kent Electric Power Co., Ltd.—are to be held on February 11th for the purpose of considering a Bill which seeks to confer further powers upon the Kent Electric Power Co., particularly to increase its capital and borrowing powers and to amalgamate the undertakings of the three companies which are controlled by the County of London Electric Supply Co.

The Kent Power Company's authorised capital is at present £2,000,000, of which £1,050,000 has been issued in £1 ordinary shares. In addition to this the company has created and issued £75,000 of 4½ per cent. irredeemable debenture stock and £2,000,000 of 3½ per cent. redeemable debenture stock. The Bill proposes to raise the authorised capital by a maximum of £4,000,000 and to increase the company's borrowing powers. The South-East Kent Co. has an issued ordinary share capital of £250,000 and the West Kent Co. £1,000,000 equally in ordinary and 4½ per cent. preference shares. Neither company has any loan capital.

It is proposed that the Kent Electric Power Co. shall allot an equal number of ordinary shares to the holders of the South-East Kent Co.'s shares. The ordinary shareholders of the West Kent Co. will be given three shares for each two shares now held by them; the preference shareholders will receive an equal number of 4½ per cent. cumulative preference shares of the Kent Power Co.

One effect of the Bill will be to give the company power to supply electricity within the whole of the County of Kent. At present it is excluded from the Isle of Thanet, in which powers are exercised by the South-East Kent Co. It is provided that the company "may by agreement purchase, lease or otherwise acquire, work, use, maintain, alter and improve any generating station or substation and the works connected therewith or incidental thereto belonging to any undertakers (whether a local authority, company, body or other persons) authorised to supply electricity in any area within or partly within or adjoining the County of Kent." Payment in respect of such transactions may be made wholly or partly in stock, shares, debentures or mortgages.

A schedule to the Bill fixes minimum quarterly charges of 10s. for each of the winter quarters and 6s. 8d. per quarter in the summer with a maximum price of 8d. per kWh for energy consumed in excess of this amount.

Machine Tools

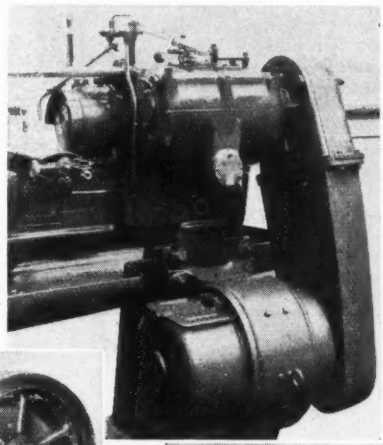
Adaptability of the Electric Motor

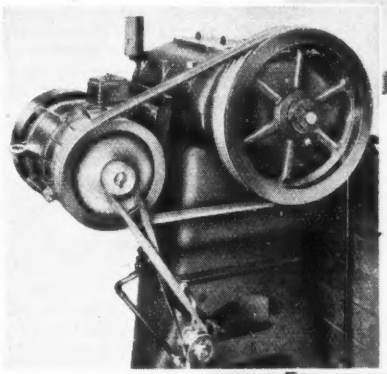
The adaptability of machine tools to various processes is enhanced by the electric drive and particularly by the incorporated motor

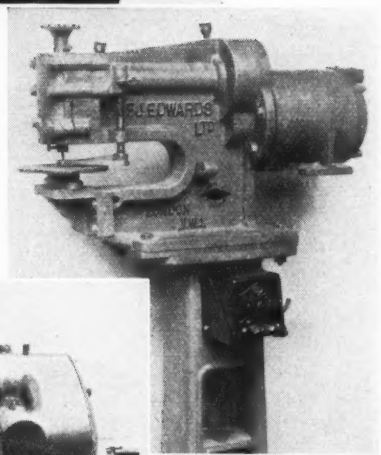
ALL munitions—airplanes, guns, ships, and so on—are produced and maintained by machine tools or by machines made by machine tools, so that the machine-tool industry is now facing the unprecedented problem of furnishing a tremendously increased volume of equipment. To ascertain how these facts affect the electrical industry we need only refer to our comments on the versatility of the electric motor elsewhere in this issue. The modern drive now stands supreme from all points of view in connection with all classes of factory installation work, and a second thought is hardly ever given to alternatives to electricity.

It is not our purpose in this article to dwell in any detailed manner on the electrical equipment of machine tools, but rather to emphasise broadly the influence of the electric drive on machine-tool work and to show how the adaptability of machine tools to modern processes is dependent upon the electric drive.

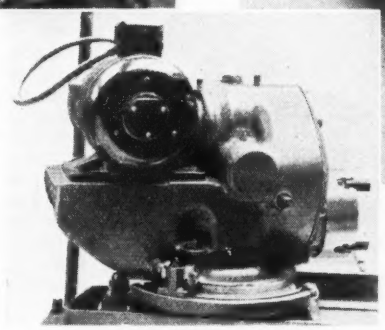
Consideration must first be given to the self-contained machine-tool. This can be placed anywhere and should it be necessary to take down a particular machine for repair or change of equipment there is no need to stop a line of machines which may be driven from a countershaft or line shafting. Nor shall we deal extensively with the more intricate modern machine tools — machines which, from the narrower technical view, may be argued to be of the greater electrical interest. Our intention is to view the subject from that most important aspect —increased production, and we propose to confine our attention to the more common machine - tool equipment, emphasising adaptability with regard to both the work and the drive. In this class is a hydraulic horizontal surface grinding machine by which hardened work of all kinds and work which cannot be handled on vertical equipment is successfully dealt with. The table traverse is hydraulically variable and any speed up to 50 ft. per min. can be instantly obtained by a simple control.







Top : Small capstan lathe with V-rope transmission Above : Converted drive on a multi-tool lathe



Work headstock of cylindrical grinding machine with automatic "sparking out" control. Above, right : A nibbling machine with flange-secured motor

This machine is entirely self-contained and is equipped with a 2-HP motor for the grinding spindle mounted on an adjustable bracket at the side of the upright ; a 3-HP motor for the hydraulic pump at the rear of the body ; and a motor-driven suds pump.

A problem to-day, greater or, at any rate more urgent, than the supply of new self-contained machine tools is the conversion of older types of belt-driven machines in order to increase their production. Many of these older machines must of necessity be introduced into motorised-equipment workshops as war extensions, although such machines are not suitable for operation in such installations. The remedy lies in the excellent conversion work which is being done, of which the following are two typical examples.

The original drive for a multi-tool shaft lathe was from a layshaft on to an overhead countershaft with fast and loose pulleys, a further fast pulley driving direct on to a special pulley with self-contained epicyclic gear on the headstock. All the countershafting was removed, a cast-iron V rib mounted directly on the special pulley, and the drive taken by V belts from a totally enclosed two-speed motor mounted on a hinged plate bolted to the lathe itself. These modifications have eliminated all vibration, improved the finish of the work and added to the accessibility of the machine. Electrical "plugging" is employed for stopping.

On an old shaft-boring lathe with countershaft transmission from a motor on the floor a new motor was mounted on a hinged plate with transmission *via* a short V belt. The speed ratio is 2 to 1, and the spindle speeds of 750, 500 and 375 RPM are obtained from the three - speed motor. Considerable floor space has been saved and vibration on the machine reduced. Of the greatest value in conversion work is the self - contained transmission unit specially designed for this purpose. The column of a particular conversion unit is designed so that the jockey pulley bracket can be adjusted both for belt tension and to suit the height of the driving pulley on the driven machine. The two positions provided for the lower jockey pulley allow the unit to be installed on either side of the machine tool and the positions of the speed indicator plate and control lever are adjustable to suit the operator's convenience.

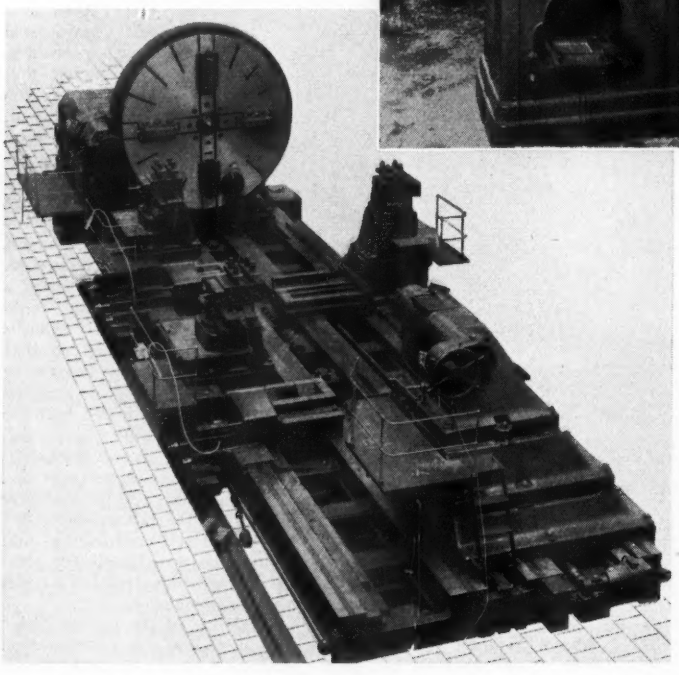
The adaptability of the electric drive to the machine tool is well demonstrated by the apparently easy manner in which motors are secured to various parts of the machines. The disposition of the motor has always been a difficult matter in connection with the simple single-support drilling machine, and in this connection a 13½-in. equipment suitable for ⅝-in. drilling is a good example. A projection near the top of the support carries flanges to which the vertical motor is secured, so as to give horizontal belt transmission at the top of the machine.

Another excellent flange-fixing scheme is in connection with a nibbling machine for such work as cam cutting and gauge making. In this case the motor is flanged-fixed to the main body of the machine and there is gear transmission. A 10½-in. centre spinning lathe represents a good example of bed extension. The extension at the back has an extra leg support and carries a DC geared motor with a cone pulley on the motor shaft which is supported at the outer end by a bearing.

In a wobbler end milling machine which will deal with rolls up to 4 ft. 8 ins. by 17 ft. 6 in. the headstock casting is arranged with all the driving gear from the motor to the milling spindle. The final transmission to the spindle is by single helical gear. The motor is mounted on a hinged bracket at the rear of the headstock, transmission to the driving shaft in which is by means of "Texropes." Reference to the apparently easy manner in which motors are mounted to machines by no means implies that any position will do, because incorrect mounting may not only upset machine accessibility and reduce transmission efficiency, but it may also alter the machine characteristics. In a 60-in. roll grinding machine transmission to the spindle is by multiple V-rope from a 30-HP motor mounted on the saddle and a countershaft allows the necessary movement to the grinding head; thus the spindle slide is free from all motor rotation problems.

On some occasions the machine can be adapted to the motor, self-contained fans from forges, etc., affording a good example. Conversion from exhausting to blowing in one case simply necessitates a pipe spigot cast on the fan inlet, while the fan outlet may be varied simply by unbolting the case from the motor; similarly, horizontal or vertical discharge are available at will.

It is important to select the correct type of motor for mounting on different machines or different machine parts. As an example, in one of the largest lathes built in this country—a 94-in. centre equipment for machining turbine rotors—the main drive is a 100-HP screen-protected continuously-rated light compound-wound reversing motor. The three 3-HP saddle traverse motors are totally enclosed, horizontal flange-mounting 15-minute rating reversing machines, while a short-term rated totally enclosed 5-HP reversing motor serves the loose headstock traverse and the grinding wheel is driven by a 15-HP drip-proof light compound-wound continuously rated motor.

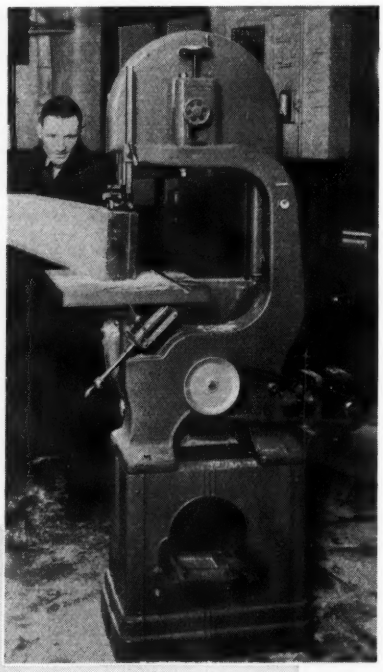


One of the largest lathes built in this country—a 94-in. centre equipment for turbine rotors

Speed variation and control must remain a matter for the closest co-operation between the motor and machine makers. The choice frequently rests between electrical and mechanical methods, and often the best results are obtained by a combination of the two. Beneficial co-operation is evident in a 60-in. roll grinding machine in which the speed variation of the 30-HP grinding wheel motor is by shunt control; the roll rotating headstock is driven by a 17½-HP constant-speed motor *via* change-speed gearing; and the 4-HP reversing motor drive for the saddle is through a gear box which provides two changes of rates of saddle traverse, giving a 2½ to 1 range in addition to the variable-speed range of the motor, which, with the Ward-Leonard control equipment, gives an overall range of 20 to 1, *i.e.*, from 1½ in. to 30 in. per minute.

For a simple ⅝-in. drilling machine there are available four spindle speed ranges, each with three speeds, up to 3,500 RPM from either DC, two-phase, three-phase or repulsion single-phase motors. The drive for a 6-in. centre wire feed capstan lathe is by a 3/2/1-HP, 15/1000/500-RPM single-phase reversing motor through a 2½-in. flat belt and three-speed cone pulleys to the spindle.

Practically every known mechanical transmission medium can be incorporated in machine tools for the control and variation of speed, and in the case of a sawing machine for the rapid cutting-off of steel tubes, sections, etc., the drive is through a pair of fast and loose pulleys and two pairs of hardened steel and gunmetal spiral gears which give the required speed to the saw spindle. The 6-HP motor of a portable radial planing machine which is carried on a revolving carriage transmits through spur reduction gear and a gear box to the worm gear for rotating the carriage. The gear box gives three cutting speeds ranging from 0.4 to 1.2 RPM, the speed changes being made through sliding gears.



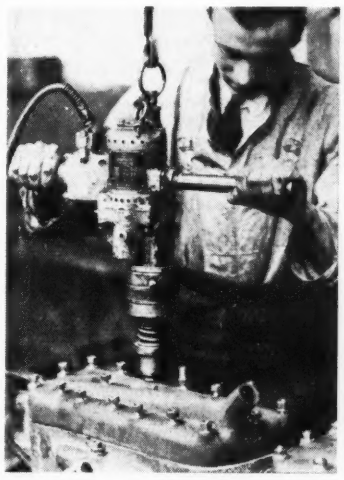
A 16-in. metal-cutting band-saw which by simple lever engagement may be converted to a directly-driven machine with a higher speed for wood-working

A precision capstan lathe has an infinitely variable speed mechanism completely enclosed in the main casting and connected to the flanged motor by twin V belts. Transmission to the spindle is by an endless belt. A precision shaper has a popular transmission arrangement—a countershaft with a three-step cone pulley, with separate adjustments for the flat belt and the motor belt. Adaptability with regard to speed requirements is well exemplified by a 16-in. metal cutting band saw which has a ½-HP 600-RPM motor. By simple lever disengagement and pin locking it may be converted to a directly driven machine with a higher speed for wood working. Further, by the use of a special back-geared motor very low speeds suitable for high-grade-steel cutting are available.

Perhaps the importance of speed control, by which we mean the attainment of correct speed rather than mere ease of speed variation, can best be brought home by a realisation that there is a correct tool speed at which the best results can be obtained for every type of material on which the tool works. As an illustration of this we take two examples from a very comprehensive list of drilling and cutting speeds. For manganese steel the cutting speed is 15 ft. per min.; while for mild-steel with a 1-in. drill the tool speed is 380 RPM with a feed of

0.014 in. per revolution. Linked up with the importance of correct tool speeds is the vital necessity of using tool materials with the required properties for their work, such as toughness. There are various ways of obtaining these properties, and we refer our readers to the article on industrial heating in this issue as a guide on this point.

Finally we must point to the importance of the precision control of the actual work, and in this connection we give the four methods available for determining the "sparking out" period of a cylindrical grinding machine for quantity production: hand control, hand control assisted by a contacting gauge, and two systems of automatic control. The disadvantages of the hand methods hardly need comment, and in one of the automatic methods the necessary "dwell" is provided by a time relay operated by contacts which are closed at the "dead" stop position. After a predetermined time a solenoid is energ sed to end the period. In the fourth method the dwell is controlled by actual contact with the work. When the correct gauge has been attained amplified current from a photo cell operates a solenoid to end the dwell.



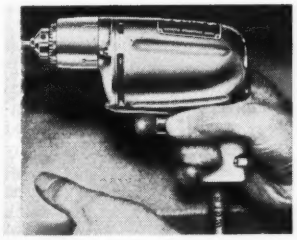
A nut runner used for driving nuts on cylinder heads

Portable Electric Tools

In regarding the portable electric tool as the little brother of the machine tool great care is necessary to avoid minimising the importance of the smaller equipment. We have often heard the opinion expressed that the portable electric tool is limited to small-scale production, but it does not require many visits to some of the largest factories engaged on the production of automobiles, aeroplanes, ships, etc., to realise the absurdity of such suggestions. Unlike the machine tool, in which the greatest interest in recent years has been the extraordinary development towards fitting the motor to the machine, an essential feature of the portable tool is the building on to the motor the working part of the equipment. This reversal of order only emphasises the relationship between the electrical and mechanical parts, and the importance of co-operation between the electrical and mechanical manufacturers. Broadly there are three methods of driving portable tools, namely, by compressed air; by universal, DC or 50-cycle AC commutator motors; and by high-frequency squirrel-cage motors.

While most portable tools in service belong to the second class we would point to the advantageous constant-speed characteristic of the high-frequency squirrel-cage motor and to the poor speed regulation of the compressed air unit. Percussive work, however, is often best performed by compressed-air equipment, and in such cases the electrical man is concerned merely with the driving of the compressor.

One of the most important points for consideration in connection with the portable tool is the relationship between weight, power and work, but special knowledge and care is required in drawing conclusions from such relationships. Weight alone is no criterion of a well-built drill. It must be considered with the power and the happy mean obtained. On this point tests on a redesigned portable electric grinder are of unusual interest. The weight of the equipment was increased by 8 oz., but the power was increased by over 30 per cent., with the result of an increase in metal removal of over 100 per cent. A $\frac{3}{16}$-in. ball-bearing drill having a net weight of 2 lb. 8 oz. has overall length and height of 6 in. and $4\frac{3}{4}$ in., respectively; light- and full-load spindle speeds of 4,200 and 2,700 RPM; and light- and full-load demands of 95 and 165 W. A "super-duty" drill with a capacity of $\frac{1}{2}$ in. for mild-steel has light- and full-load ratings of 230 and 540 W, respectively, and light- and full-load spindle speeds of 680 and 370 RPM.



An important consideration is the relationship between weight, power and work; a $\frac{3}{16}$-in. ball-bearing electric drill

These relationships emphasise that, although the torque of the motor is limited by size, its HP output is a function of speed. For example, a motor normally rated at $\frac{1}{4}$ HP 50 cycles, 3,000 RPM, can be designed to give as much as 2 HP at 24,000 RPM (400 cycles) with an overload capacity of at least four times full-load torque.

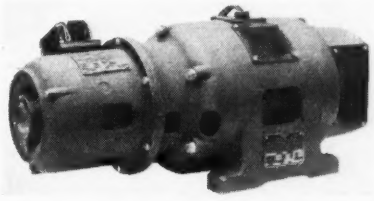
All this, of course, is in favour of high frequency, the adoption of which necessitates a frequency changer as the source of supply for the tools. A typical frequency changer set consists of a squirrel cage motor driving a slip-ring motor backwards, i.e., against its own rotating flux. The e.m.f. across the slip rings is thus a "slip" frequency which has been increased to the desired high frequency. The driving motor is small, by reason of the fact that part of the power imput is supplied direct to the frequency changer stator, while the remainder is supplied mechanically through the driving shaft.

Bearing stability is of outstanding importance in portable tool operation, and a particularly interesting feature in this connection is the mounting of the main spindle of a heavy-duty drill on tapered roller bearings. These bearings carry the heavy thrust and radial loads which are of a severe character and may be applied in a number of directions.

Another scheme in this connection is the use of a motor bearing cartridge which, besides giving greater stability by holding the bearings rigidly in position, permits quick adjustment to be made.

Apart from the tool proper, maintenance of the portable electric tool almost exclusively resolves itself into a motor-maintenance problem, the importance of which we have stressed in another article in this issue.

We commend, however, such practice as the provision of a tangentially bladed fan to supply a constant flow of air through the motor to ensure maximum output. Another close comparison which can be made with the more orthodox motor practice is the provision of two half-castings in which the interior is assembled. The counterpart of this system is the split casing of a heavy-duty steelworks motor which permits easy accessibility and maintenance.



An overhung tandem frequency changer

Safety measures are obviously of outstanding importance in connection with tools that are actually handled, and every user should be able to appreciate the significance of earthing. The safety features of a portable saw are a momentary contact, a double-pole switch and a swinging guard which instantly covers the blade when the saw is disengaged.

As we have already done in the case of the machine tool proper, we conclude by stressing the fact that equipment can only give of its best if it is used on the work for which it is designed.

Acknowledgment

We wish to thank the following manufacturers for the valuable guidance which they gave us in the preparation of this article:—

E. H. Jones (Machine Tools), Ltd., Charles Taylor (Birmingham), Ltd., S. Wolf & Co., Ltd., E. P. Barrus, Ltd., British Thomson-Houston Co., Ltd., F. J. Edwards, Ltd., John Lund, Ltd., Brook Motors, Ltd., H. W. Ward & Co., Ltd., Craven Bros. (Manchester), Ltd., Charles Churchill & Co., Ltd., Thomas Chatwin & Co., B. E. N. Patents, Ltd., Beacon Engineering Co., William Allday & Co., Ltd., Higgs Motors, Ltd., Macrome, Ltd., and the Sun Electrical Co., Ltd.

CORRESPONDENCE

Every letter must be accompanied by the writer's name and address preferably, but not necessarily, for publication. The Editors cannot accept responsibility for correspondents' opinions.

Reviving Dry Cells

IN a recent review of a new book on dry batteries the author is said to maintain that there is no practical way of reviving a spent cell. It depends on what is meant by "practical." It may not, at present, be commercially practicable because battery manufacturing works are laid out specifically for the mass *production* of batteries and not for *reviving* spent batteries. This involves a different technique, but I should not think it impracticable in the sense that it can't be done.

A couple of years ago the dry battery used on a bell circuit from my garden gate gave out after a reasonably long life. It was not convenient at the time to obtain new cells so I set about to revive them. I argued to myself that there is really no such thing as a *dry* battery and that the so-called dry batteries commonly used for operating bells and electric torches are, in principle, Leclanché batteries in which a moist, as distinct from a wet or fluid, exciter is employed. So I bored two ¼-in. diameter holes through the sealing compound of each of the three cells by means of a hot skewer and then poured hot water through the holes until the cells appeared to be full. After allowing the water to soak in thoroughly, I drained it out and, having no salammoniac, I replaced it with salt water. The battery served its purpose quite well for some months after which the bell sometimes failed to ring or rang faintly.

Not to be discouraged I washed out the cells again and re-charged them with a salammoniac solution. This was a simple operation, as I had not sealed up the holes in the top. With the salammoniac exciting fluid the battery worked quite satisfactorily for a year or more when trouble occurred owing to corrosion of the terminals due to the fact that again I had not sealed up the holes.

More recently, when torch batteries were hard or impossible to obtain, I decided to try to revive two derelict torches which had been lying dead for some months in a drawer. One had a two-cell cylindrical battery measuring 4 in. by 1 in. Owing to the restricted space between the central pole and the outer zinc case, it was not practicable to enlarge the hole much more than the diameter of the skewer. I used a medicine dropper to inject the hot water, and also to suck it out again and, afterwards, to inject the salammoniac solution. A fountain pen filler would do equally well.

In this case I did seal up the holes by means of a gas jet. It could be done by means of a hot iron perhaps equally well. In a subsequent attempt on a much smaller battery, I sealed the holes with ordinary sealing wax which appeared to unite readily with the original sealing compound. I am not quite satisfied with the results as regards the smaller battery, which had been lying short-circuited for a long time, but I shall open it up and try again.

As to the larger of the two torch batteries, I am quite satisfied. For some weeks now I have used it on patrol during the black-out and there is no indication that it will not last as long as it did when new, but the practicability of reviving spent batteries on a commercial scale is one for the manufacturer to decide.

Coulsdon, Surrey, *Jan. 26th.* FRANK BROADBENT.

Roof Spotters

At a factory in Southern England where I am engaged the order regarding "spotters" has presented many problems. The factory is in a valley surrounded by trees and on one side a hill rises some 400 ft. above it. The only feasible place for "spotters" was on this hill where a 30-ft. steel tower was erected 550 yd. from the works.

The tower is heated at the top by a low-temperature unit sunk under the duck boards, so as to keep the spotters' feet warm at least. This unit, a tubular one forming a 3 ft. 6 in. square, has a loading of 600 W at 230 V, and is fed from the works by overhead lines. Control is through a 15-way lead-covered telephone cable supported from a catenary and connected direct to the A.R.P. control room, where a ten-line manual set has been installed, linking the spotter to any of the A.R.P. services.

The warning is given by 12-V car-type horns sounded by battery-operated relays controlled only by the spotter. A four-way switchbox in the control room gives the spotter the colour of the warning in operation immediately it is received. One of the obstacles encountered in linking the post to the works was an overhead span up the face of a chalk quarry some 150 ft. high.

The whole system is tested once daily. Since the date of its inauguration there have been 61 hours of "alert" periods, but to date only half-an-hour has been lost due to raids. The whole installation was carried out by the works electrician, excepting the overhead cables, which were erected by the local supply undertaking.

January 13th. J. A. HILL.

Electrically-propelled Ships

I am grateful for the very generous notice that your reviewer gave to my small book, "Electricity Applied to Marine Engineering." Unfortunately, however, he has made a statement which might prejudice a marine engineer unfavourably, and which is actually incorrect. I refer to the passage in which he says :—

". . . the author, while giving a chapter on Diesel-electric propulsion in which DC is used, does not mention turbo-electric propulsion in which AC is generally employed."

If your reviewer will refer to pp. 203-205 he will find a general description of the turbo-electric equipment, together with the sequence of operations for starting and stopping, together with a short explanation as to why the self-starting synchronous motor is used in preference to the induction motor. Actually, the description of the turbo-electric equipment is fuller than that of the Diesel-electric equipment, though admittedly it did not have a chapter to itself, but was included in the general chapter on AC motors.

It is unfortunate that this particular point should have been chosen for critical comment—I am only too well aware that there is much in the book which might be adversely criticised, as it was largely written against time—but I bear your reviewer no malice, particularly in view of his otherwise very kind remarks about the book.

Blackheath, S.E.3, *January 22nd.* W. LAWS.

Vision in Poor Light

THE fundamental principles of vision in very weak light are discussed in a paper prepared by Dr. W. D. Wright for recent presentation before the ILLUMINATING ENGINEERING SOCIETY in London.

A scale of subjective brightness, which it is suggested may also prove to be a satisfactory means of specifying contrast, is proposed, in terms of which the changes in sensitivity of human eyes can be recorded. An experiment is described which enables changes of the eyes that take place during their downward adaptation, other than to complete darkness, to be appreciated in a very striking manner and by means of which the time needed for such adaptation can be recorded.

The effect of the area of an object on its visibility is mentioned briefly and the action of a glare source in depressing eye sensitivity and in delaying its recovery is described; this is followed by an indication of the extent to which contrast is affected by reduction both of illumination and of area.

A simple test for defective night vision, newly devised by the author, is described, together with preliminary results which indicate that some 5 per cent. of nearly 300 people examined required more than four times the light needed by normal persons, and that some eyes adapt themselves more rapidly than others.

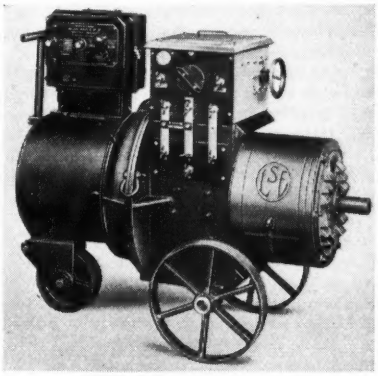
The unit of subjective brightness is the "brill," for the measurement of which a "meter" has been devised in the form of a portable binocular matcher, consisting of a simple optical system illuminated by a 4 V lamp. Mr. E. Shand helped in its construction in the Imperial College workshop. The author acknowledges financial aid rendered by the Medical Research Council and his appreciation of Mr. A. W. Beuttell's early pioneering work in this field.

Welding Appliances

Standardisation of AC Transformer Sets

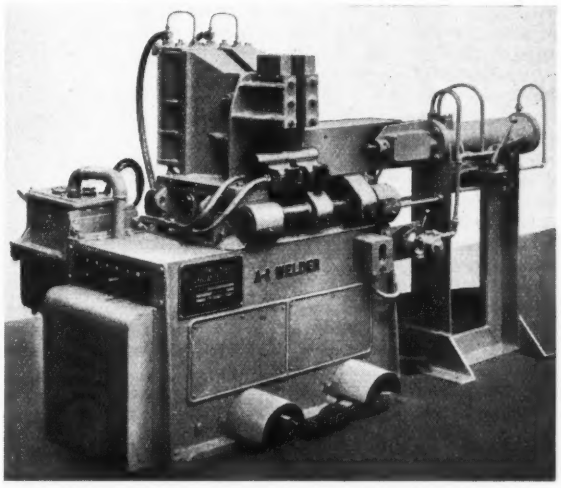
WELDING first became prominent as a convenient means of re-uniting fractures, and of building up worn parts by the deposition of fresh metal. To-day it is outstanding as a valuable aid, readily adaptable to factory production methods, to the homogeneous joining together by fusion of pre-cut component parts in the fabrication of whole machines and structures and vessels of different kinds. There are numerous variants, including automatically operated models. Which are likely to be most readily available, or generally serviceable, in the prevailing circumstances ? Certainly not those representing individual users' modifications of established makers' designs. Standard equipment manufactured for stock is invariably cheaper and most easily obtainable.

For example, when a large works ordered fifty equipments from the English Electric Co., Ltd., they were supplied and put into service in just over a fortnight. This company has standardised AC arc welders, (although it has made DC sets for years as they are preferred for non-ferrous metals and for bare wires) and has exported a good deal of this equipment. Sound economics and good engineering urge the use of the largest electrode and current possible for the job, because it increases the rate of metal deposition, which means quicker welding. To meet these requirements the company offers 300, 400 and 600 A sets, the last-mentioned being suitable for $\frac{3}{8}$-in. electrodes of any make.



Laurence, Scott transportable "K-S" 12- to 300-A welder

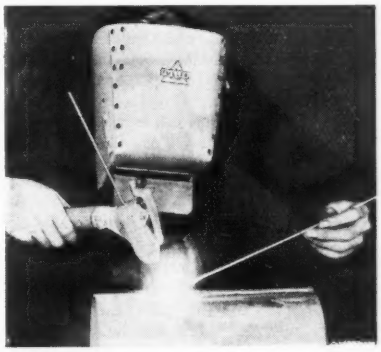
The smaller FWC. 210-17-A set (the figures represent the current limits) is specially useful in fabrication shops, enabling metals of from 20 gauge up to 0.5 in. thickness to be welded in one run, while thicker sections can be dealt with by multi-runs. It is a good example of straightforward design and built for rough usage. A transformer that may be mounted on wheels feeds one regulator in the same oil tank, or several in separate weatherproof tanks, so affording each operator independent control by means of an externally operated tapping switch calibrated in welding amperes, rendering metering instruments unnecessary. The interconnecting plugs and sockets are insulated and mechanically protected and interlocked. To compensate for voltage drop in the cables the primary tappings may also be used for secondary adjustment. The two windings, being independent, avoid the shock risk associated with auto-transformer regulation.



A-I automatic flash welder with tube stripper

Welders who refrain from special demands help the manufacturers to plan their production and at the same time secure better delivery for themselves as well as the manufacturers' other customers. There is no doubt that appreciable standardisation is being achieved. The Quasi-Arc Co., Ltd., attributes this largely to the wide availability of AC for operating transformer sets.

A typical transportable example is the ACP type, oil-immersed in a tank on two wheels and swivel caster, with eye bolts and handles and cleats for the trailing cables when not in use. For regulation there is a choice of four output sockets in addition to a hand-wheel which controls a multi-position knife switch to provide 40 different values of welding current. Stock single-phase sets can be connected to any two of three line wires. Although as many as 24 operators can be served by a single transformer, it is more usual to install several three-operator or six-operator sets.



Fuller carbo-flux holder and protective helmet

For certain classes of work needing special electrodes there are advantages in using DC arcs, for which motor-generator sets are essential; transportable single- or double-operator plants are the most popular; large engine-driven sets are not recommended.

Coincident with the evolution of the oil-immersed AC arc welder delivering from 30 to 300 A for general application, as adopted by Bonar, Long & Co., Ltd., practical experience has shown that for such an output range the number of increments between the lower and upper limits of output need not exceed 36 if arranged logarithmically so that the current changes are small at the lower outputs and progressively increase. The lower values allow for the use of 14-gauge electrodes for the welding of thin material, say $\frac{1}{16}$ in., thick, whereas the maximum output permits the use of a 4-gauge rod for such heavy fabrication work as shipbuilding and, furthermore, it is possible to work two standard plants in parallel so as to obtain double the output from each tapping setting, up to 600 A, which is sufficient to weld satisfactorily with the largest-gauge electrodes marketed.

Usually the number of regulators associated with a multi-operator transformer is a multiple of three, so as to preserve load balance on the three phases of the transformer. A drooping characteristic automatically adjusts the arc voltage to suit the particular grade and size of electrode being employed, which is an advantageous feature, since the trend is towards the use of "shielded arc" types of electrodes which cause a relatively large arc-voltage drop.

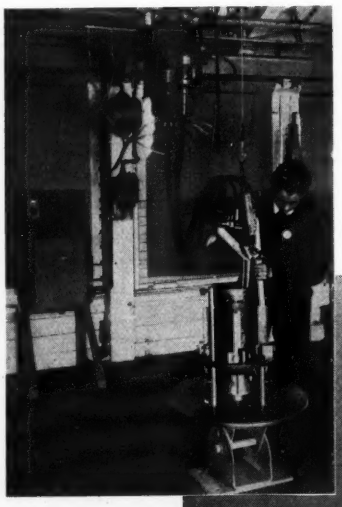
While agreeing that in many instances DC is more satisfactory, Transformers and Welders, Ltd., feel that the general handiness of AC equipment is of much wider application than is sometimes

recognised. It calls for a higher standard of skill on the part of the operator, in that he must not draw out the arc to such lengths as would be quite practicable with DC, but this necessity has compensating advantages. The sets made for stock include 25/145-A and 30/250-A single-phase models as well as 30/250-A three-/single-phase outfits that do not incorporate any tappings and can be arranged for connection to practically all normal mains.

Rotary " K-S " welders produced by Laurence, Scott & Electromotors, Ltd., are adjustable from 8 to 200 A in the case of the small size and from 12 to 300A in the large. They are made in many forms, but that which satisfies most needs consists of a generator driven by a flange-mounted AC motor and provided with wheels for transport. The starter, mounted on the motor, is arranged to permit operation in the star position on light loads, reducing consumption of power. The output regulator, mounted on top of the generator, is detachable so that control may be exercised locally by the operator when working at some distance from the machine. There is one handwheel only, together with links for the high and low ranges, a polarity switch being added to the larger size. This plant is also supplied in the form of a generator, to be driven by an existing engine or from shafting, performance not being critically affected by slight speed variations, but " specials " are not encouraged just now unless out of the ordinary needs happen to be essential.

A single-operator set with a built-in regulator as well as multi-operator sets with separate regulators are stocked by the Fuller Electrical and Manufacturing Co., Ltd., in four sizes (25/210, 30/300, 50/400 and 100/600A) with a 36-step welding range. Both transformers and regulators are oil-cooled, and built to B.S.S. 171/36 and 638/35. Additionally the " carbo-flux " process has been standardised for the welding of accessories made of light gauge metal as well as heavier gauges of brass and copper. The method of application to 18-gauge stainless steel cylinder with the aid of a carbon holder and coated filler rod is illustrated.

Air-cooled " Breco " sets are made by Brentford Transformers, Ltd., in sheet steel splash-proof enclosures. Primary tapping terminals provide a choice of six inputs from 170 to 500 V, with simple handwheel regulation of the ten-to-one output range at two secondary voltages, the higher one for welding thin materials or for use with special electrodes. The handwheel raises and lowers a magnetic yoke, so ensuring gradual current change according to graduated scales. Single-phase sets are rated at from 10 to 20 kVA, an extra charge being made for three-phase input sets.



Although the rotary machines available from A. Reyrolle & Co., Ltd., range from a light 50-A single-operator machine to a set capable of serving as many as 80 operators for shipyard use, the most generally useful is, again, the single-operator set of from 20 to 300 A of drooping characteristic design. To the performance associated with the well-known Holmes generators, internal constructional features since introduced include a special compound field system and a completely laminated magnetic circuit in a welded frame. These machines are suitable for fully-fluxed, dipped, or bare-wire electrodes from 2 to 18 SWG, or carbon electrodes for light-gauge welding. Current is chosen simply by plug-and-socket selector and closer adjustment is obtained by means of a small regulator. When motor driven (AC or DC) the generator is a composite unit, the two rotors being on a common shaft in ball and roller bearings, protected by under-voltage and time-lag overload releases.

The Runbaken " Easiweld " is constructed in cabinet form on castors, the welded steel housing being drip-proof. It is suitable for sheet metal work up to 0.75-in. plate, a handwheel regulating output up to 125 A. The input rating is 6 kW for 20 minutes continuously, or more when used intermittently.

A comprehensive series of flux-coated electrodes which are metal-cored to suit most arc-welding requirements is offered by the Metropolitan-Vickers Electrical Co., Ltd., together with both DC and AC machines. The latest " Thermac " transformer set on wheels affords smoother control than was obtainable with the coarser settings of the older plug-and-socket tappings. Apart from users' preferences, there is no inherent difference between the 200/300-A air-cooled and 200/300/400 A oil-cooled sizes. Separate controllers may all be fed from a single transformer and likewise for more than one or two operators from the DC rotary " Paradyne " sets, which are made to B.S.S. 638 in 200/300 A sizes. They are available from stock for either AC or DC drives as a motor-generator on a common shaft and built into one frame.

In most instances M-V manipulators will speed up manual work ; they are used for mounting the assembly fixtures so that the most convenient positions can be chosen for downhand welding, so avoiding " flow " difficulties, resulting in better welding and substantial savings in cost.

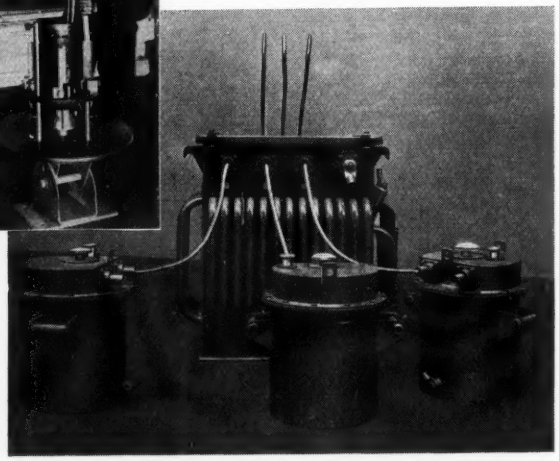
Contact Resistance Methods

Obviously the manipulator idea is not solely applicable to arc welding. The " Metrovick " example illustrated demonstrates how conveniently work can be jigged during assembly and spot welded by means of movable jaws energised through trailing cables, so eliminating a great deal of handling time.

This contact heating principle yields large repetition outputs, fluxes or filler rods not being needed. For detail work a bench type of spot-welder is available with either a trip-switch control or, for precision work, a half cycle Ignitron valve timing panel. Probably the most popular M-V spot welder is the " F.S." which is made in four sizes and three electrical capacities for all general classes of mild steel up to a total added thickness of $\frac{3}{8}$-in. and the special pressure adjustment (up to 600 lb.) and timing arrangements ensure reliably consistent results.

An equally comprehensive variety of M-V butt and flash-butt welding machines is stocked, ranging from the 2.5 kVA model capable of butt welding $\frac{1}{4}$-in. diameter mild steel wire up to the heaviest hand-operated 120-kVA flash-butt machine with a capacity of 8 sq. in. compact section of mild steel. Certain non-ferrous metals like copper must be welded by the slow-butt process and for this large variety of applications widely differing types of machines are available.

Resistance welding for " mass production " is a speciality of of A.I. Electric Welding Machines, Ltd. Spot welding, for instance, replaces rivets in repetition work, thus saving weight and obviating the drilling or punching of holes ; the joint is made flush on both sides. The system ensures speed of assembly and low working costs. Mild steels are most amenable to this process, but it may be successfully applied to stainless and coated steels, brass, nickel, monel metal and aluminium alloys. Inexpensive machines, simply operated by foot pedal, with arms 12 to 36 in. long will deal with plate widths up to twice the arm length.



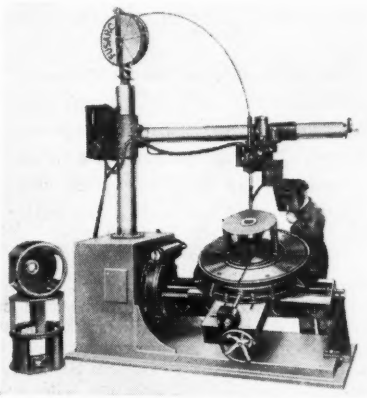
English Electric multi-operator regulators with common transformer and (above) a Metrovick mobile spot welder with simple manipulator

An alternative vertical sliding-head type, actuated by compressed air, is capable of accommodating combined plate thicknesses up to 0.5 in. for single or repetition work at speeds up to 120 spot

welds per minute. Fully automatic operation is achieved by the incorporation of Thyratron valve control, exercised by the simple action of depressing a push-button.

When an assembly calls for a concentrated cluster of spot welds it is advisable to complete the group simultaneously in one stroke of the machine. The material is first prepared by being dimpled, small projections being raised where required ultimately to form the welds. The advantages of this "projection" process are speed, uniform consistency and elimination of electrode maintenance.

Problems encountered in intricate forging and machining operations have been solved by flash-butt welding. Sections up to 0.75 sq. in. in area are clamped in the jaws of a semi-automatic hand-operated machine, the operation being completed by the forward movement of a toggle lever. A machine tooled up for cycle wheel rims will complete 180 per hour. A larger model rated at 50-kVA for the automatic butt-flashing of tubes has on its right-hand side an air-operated stripper which removes the internal fin after welding; both the clamps and upsetting mechanism are also air operated. This model will deal with sections up to 1.5 sq. in. in area. Standard power-operated heads for seam welding for containers that must be gas or liquid tight are available in capacities up to 120 kVA with arm lengths up to 36 inches.



"Fusarc" automatic head mounted on jig for circumferential welding

Special Machines

Reverting to arc welding of a rather more special-purpose class, the essence of the system devised by the "Fusarc" Welding Co., Ltd., is speed and uninterrupted building-up, achieved by the utilisation of a wire-like electrode uncoiled off a drum. The arc length and electrode feed are governed by a system of magnetic clutches operated automatically by relays in the electrical circuit, so that constancy is maintained, even over rough surfaces, and because the electrode feed rollers are directly driven from the clutches there is no lag in the response.

There are two types of automatic head; stationary and tractor, the main difference being that in the latter type the traverse is controlled by a variable-speed motor which can be pre-adjusted, so that the head runs smoothly over the work at a constant speed. The continuous electrode assures uninterrupted current contact. It consists of a central core which is spirally wound with an auxiliary wire, and on to this the flux is extruded. It is then bound with steel tape which provides the contact with the core wire and protects the electrode from damage.

This process can be applied to various classes of fabrication. A contract is nearing completion for the construction of two complete assemblies for the building-up of worn wheel flanges in the workshops of the Federated Malay States Railways.

"Metrovick" equipment for atomic-hydrogen welding is stocked in two sizes, for light sheet-metal work and the repair of all classes of alloys. A single-phase AC arc is maintained between the tips of two adjacent tungsten electrodes while hydrogen (or "cracked" ammonia) gas is fed to the arc from nozzles. The energy of the arc, combined with the catalytic action of the electrodes, is responsible for the dissolution of the molecular gas into its atomic state, the recombination of the atoms resulting in the liberation of heat far in excess of that obtainable with any other sort of gas flame. This heat fuses the metals to be joined, together with a filler rod if additional metal needs to be deposited.

Electro-plating *(continued from page 324)*

improvement in the characteristic which increases the rating by about 25 per cent. without sacrificing efficiency or reliability. This plant is an alternative to DC dynamos or motor generator sets and the introduction of the "Westalite" rectifier which may be oil immersed, will be of interest to the plating shop; it may be placed alongside the baths if required.

For fine regulation of voltage or current there is a Westinghouse 63-step controller employing three commercial type switches; for heavier current an oil immersed on-load switch is employed. Certain processes are spoilt if the power supply fails, involving a considerable loss. A standby battery will supply sufficient current to prevent damage while the work is removed from the vats and rinsed, and may be switched on by means of a change-over contactor. The Westinghouse scheme whereby the battery is permanently connected to the plating bath through a half-wave rectifier allows the battery to discharge but prevents it from receiving too high a charge under normal running conditions when a 4-V battery is used in conjunction with a bath operating at 8 V at full load. The diagram shows how the battery is kept in a healthy state by trickle charging, controlled by the resistance C, while it can be recharged after a supply failure from the rectifier or generator feeding the plating bath, by closing the switch D, which short circuits the rectifier A, the resistance B being used for adjustment of the current. If the power fails while the battery is being charged, it discharges into the bath without any interruption, but the current will be somewhat greater than usual until the switch D is opened.

How to Anodize

Anodizing differs radically from other forms of electrode-position in that, as the name implies, the "work" becomes the anode instead of the cathode. Oxygen is deposited at the anode and a compact, adherent wear-resisting coat of hydrated aluminium oxide is formed in the surface of the work. Besides its wear- and weather-resisting properties, the film also has the advantage that it will take dye.

A chrome plating plant can readily be converted into an anodizing outfit. The advice of Coleman & Appleby, Ltd., is to remove the old solution from the tank, and clean the latter well before the anodizing solution, which consists of 3 per cent. chromic acid by weight, is introduced. A water cooling coil must be fitted in the tank to reduce the temperature when necessary, and some form of agitation for the solution is advised. Sheets of stainless steel are suspended by stainless steel hooks from the cathode rods.

The articles to be treated are well cleaned and suspended from the anode rod into the solution by aluminium wire. The voltage is raised from 0 to 40 V for 35 minutes more, then raised to 50 V gradually over 5 minutes and maintained at 50 V for 5 minutes more. Thus the whole operation takes one hour. The temperature of the solution is maintained at 104-111 deg. F. The work is then well swilled in cold water and dried.

Hard chrome plating is in great demand today for building up the thickness of worn gauges, besides giving a harder surface to cutting tools and dies, moulds and the wearing parts of machinery.

Worn motor parts, such as axle shafts, etc., have been repaired by the deposition of a thick film of nickel over the worn part. The wear resistance afforded by nickel is out of all proportion to its hardness compared with that of iron. A nickel plating plant can be easily converted for heavy nickel plating if the match-boarding be stripped off and replaced with reinforced glass. The vat must be well cleaned out and heating arranged for, which can be done by electricity. An air agitation system is necessary and with this can be arranged a simple filtering method.

A great deal of cadmium plating is being done because of its excellent rust-proofing qualities. For ferrous metals the plant required is exceedingly simple, comprising a plain iron tank with wooden frame and insulators. Cadmium anodes with steel hooks and cathode rods are connected to the positive leads respectively; heating or agitation are not required.

Salvage by the restoration and reconditioning of parts that have been worn in service, or have inadvertently been machined below the proper dimensions was the original nucleus of the business of Fescol, Ltd., whose cold process is claimed to leave the structure of the basis metal unchanged and undistorted.

The Runbaken "Easydun" plating outfits are intended for small work; they can be arranged for battery AC of mains operation and a time switch can be added.

Electro-plating

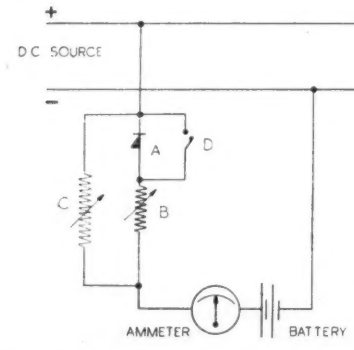
Utility rather than Appearance its Present Use

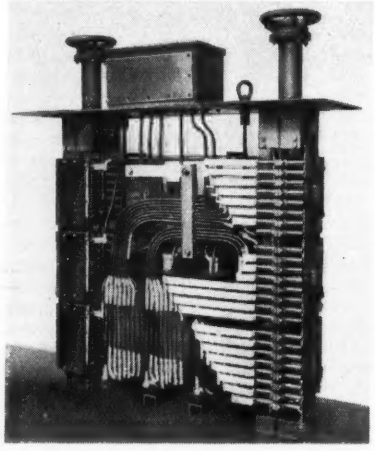
FROM being merely a way of improving appearance of the article treated, and possibly adding to its value, electro-plating has become of industrial importance for hardening surfaces against wear, protecting against corrosion, imparting a conducting "skin" to normally insulating materials like ceramics and "plastics," or otherwise conditioning surfaces for subsequent processing.

Electro-plating is no longer used solely for the sake of appearance, but primarily for hardening surfaces, protecting them against corrosion, or imparting a conducting "skin" to normally insulating materials

Examples of the formation on inferior bases of superior metallic and oxide films to resist corrosion, are the plating of steel with cadmium, or zinc, and of non-ferrous metals with tin, nickel, or lead, which is done in most cases in the conventional manner, in plain iron or lead-lined tanks containing an appropriate electrolytic solution. The "work" forms one of the two immersed electrodes between which a large unidirectional current at low voltage is caused to pass. These processes do not differ from those normally employed in plating, for which a representative range of plant is manufactured by W. Canning & Co., Ltd., except that a definite thickness of deposit, free from pores, is usually specified.

For the protection of aluminium special treatment is needed to produce a hard oxide film on the surface. This is accomplished by making the article the anode in a bath of chromic or sulphuric acid. In each case very careful regulation of the voltage and temperature is essential. Insoluble cathodes are used. The tank, or its lining, is connected to the negative busbar and auxiliary cathodes of stainless steel (for the chromic acid bath) or lead (for the sulphuric acid bath) are employed.





Above: Westinghouse emergency power supply system

Right: Heavy duty on-load oil immersed control switch

The arrangement of the tank for the chromic acid process is similar to that used for chrome plating, with fume exhaust ducts and fan. Agitation is afforded by means of compressed air, or by circulation of the electrolyte. Cooling coils are also needed and thermostats are often fitted.

In the equipment for sulphuric anodising the tank, which is of lead, is supported on an expanded metal basket and is provided with a water jacket. Cooling coils and agitation pipes are fitted inside the bath, and heating and cooling are effected by pipes in the outer jacket.

The building-up of worn parts and surface hardening by the application of deposits of nickel or copper and chromium greatly exceeding in thickness those used for decorative plating, calls for specially designed equipment. Rotation of cylindrical objects is sometimes desirable and constant circulation and filtration are frequently needed. The correct amperage must be applied for a specified time to form a specific thickness of coating. Problems of adhesion have to be carefully studied and prior electrolytic etching is usually essential to secure a firm bond between the two metals.

The printing trade makes use of heavy copper deposits for the production of photogravure cylinders, and thick shells are also built up for gramophone stampers and searchlight reflectors. When coatings are needed to inhibit or assist local chemical action the aid of electrodeposition is often sought in the local protection of metals which are to be subjected to heat treatment and hardening processes. Coppering, before case hardening, is the commonest example, but many more applications of the process are now in daily use. For instance, there are the electro-tinning of aero-engine cylinder barrels, and the copper-nickel coating of austenitic steel pistons before nitriding.

Examples of the part played by electro-plating to assist chemical processes are the use of electro-tinning to aid soldering, and the electro-brassing of steel and iron to secure rubber adhesion.

Heaters for practically all types of plating plant take the form of immersion elements sheathed in suitable corrosion resisting material, which may be anything from antimonial-lead to such substance as inconel. They are made by Geo. Bray & Co., Ltd., who have also supplied heaters for special processes, such as potassium sodium nitrate hardening baths and oil hardening vats.

It is essential to guard against any possibility of fumes percolating into the interior of the element and causing breakdown of the insulation. Messrs. Bray have overcome the trouble by using inconel sheathed immersion heaters in conjunction with a busbar chamber with packed joints.

Typical Process Systems

Apart from chromium plating for decorative purposes, heating elements for use in aluminium kettles are chromium plated to prevent anodic corrosion due to electrolytic action.

Hard chromium deposits, of considerable thickness if required, are used to build up a wear-resisting layer, or to restore worn steel parts, such as rotor shafts, to their original dimensions. A voltage of 6-8 is generally sufficient and a three-phase system is desirable.

Nickel is used to reduce the temperature of certain parts, by increasing the heat transfer by reflection. Black nickel on a nickel alloy base is used for nameplates, lettering showing bright on a black ground, which is removed locally by etching or engraving. While a three-phase rectifier is generally used on account of the magnitude of the load, single-phase rectifiers up to 4,000 A have been successfully employed. Voltage is usually about 3-4, but for awkward shaped parts as much as 6-7 V may be required.

Thin copper or nickel foil is cheaper to produce by deposition than by rolling down a thick billet. Two metals can be deposited one on another for use in thermostats, or nickel on copper for domestic cooking ware. Tin is largely used for food storage, forming a clean and non-porous film, which resists corrosion. Mirrors can be built up by "silvering" a glass master mirror, then building up a substantial copper shell, when the master is removed and the surface of the shell is rhodium plated.

Power Supply

Westinghouse copper-oxide rectifiers of an aggregate output capacity exceeding one million amperes have been installed for electrodeposition. Recent developments are a new design of element which embodies protection against moisture and an

(*Continued on preceding page*).

COMMERCIAL AND INDUSTRIAL

Industrial Lighting Service. Fire Guards Order. Boiling Plate Decision.

Factory Lighting

As our readers know, the National Industrial Electric Lighting Service has been formed by the electrical industry to facilitate the carrying out of regulations based on the Fifth Report of the Home Office Committee on Factory Lighting, and to place a complete service at the disposal of factory owners and executives without charge.

A meeting of the Northern Counties Committee of the Service, under the chairmanship of Mr. V. A. H. Clements (North-Eastern Supply Co.), was held at Newcastle on January 17th, at which steps were taken to ensure that the work of the Service would receive the widest possible publicity in that important industrial area. Arrangements have already been made to deal promptly with all inquiries, and factory owners should apply for advice on lighting matters arising from the Regulations to the Local Secretary, N.I.E.L.S., 47, Pilgrim Street, Newcastle-on-Tyne.

Fire Prevention Order

The Minister of Home Security has made the Fire Prevention (Business Premises) Order, 1941 (Stationery Office, 2d.), which provides that the occupiers of commercial, factory and other premises shall make arrangements for the continuous presence at the premises of an adequate number of persons and equipment for discharging fire prevention duties. If the occupier is unwilling or unable to comply with the Order the "appropriate authority" will make the arrangements and charge the cost to the occupier. No person shall be required to discharge fire-prevention duties for more than forty-eight hours a month outside his normal working hours, and there are certain exemptions. Occupiers of neighbouring premises may make joint arrangements to comply with the Order. The "appropriate authority" in the case of factory or commercial premises forming part of an electricity undertaking is the Electricity Commissioners.

Family Allowances

The Midland Electric Manufacturing Co., Ltd., has introduced a scheme of family allowances, in addition to "supplementary grants" which are already paid to all employees to offset the normal rise in the cost of living. The directors have worked out a scheme which provides additional weekly payments for each dependent child. The scale is generous, being 3s. for the first child, 2s. for the second and 1s. for the third and subsequent children.

The scheme, which it is hoped to operate at least for the duration of the war, applies to all works employees and to members of the staff below the £300 a year salary level.

Transport Workers' Wages

On January 17th the National Joint Industrial Council remitted to the Wages Committee for consideration an application for increase in wages on behalf of those employees whose wages are normally regulated by decisions of the N.J.I.C., which has been made to the Municipal Transport Association, the London Passenger Transport Board and representatives of the company undertakings. Mr. H. E. Clay stated that the claim was for an advance of 10s. a week above the present "war wage." The representatives of the employers were of opinion that the application was premature and suggested that the employees' side should defer the application for three months. The employees' representatives, however, contended that the application called for immediate attention. A meeting of the Wages Committee to consider the application will be held on February 14th.

Cable Makers' Wages

The Joint Industrial Council for the Electrical Cable-making Industry states that the rise of the cost of living figure to 96 per cent. above the 1914 level will not involve any alteration in wages on the third pay-day in February, 1941.

The Cost of Living

The Ministry of Labour and National Service announces that at January 1st the official cost-of-living figure was 96 points above the level of July, 1914, as compared with 95 points at November 30th. The rise of one point was due to increases in the prices of clothing and of coal. For food alone, the index figure at January 1st was 72 points above the level of July, 1914, as compared with 73 points at November 30th. The rise during December in the prices of clothing (including clothing materials) was largely attributable to the effects of the Purchase Tax. Since this tax came into operation, on October 21st, the resulting increases in prices have raised the cost of living index figure by about 2½ points.

Boiling Plate Guarantees

In our advertisement pages to-day a number of boiling plate manufacturers announce a reduction in the guarantee period applicable to their boiling plates (solid and radiant patterns, mains voltage) to twelve months from date of dispatch; similarly the guarantee on l.v. transformer-operated plates will be reduced to 24 months. These revised guarantees will operate from February 1st. The manufacturers concerned are as follows:—Belling & Co., Ltd., De Brunner & Lang Sims, English Electric Co., Ltd., General Electric Co., Ltd., Hotpoint Electric Appliance Co., Ltd., Jackson Electric Stove Co., Ltd., Metropolitan-Vickers Electrical Co., Ltd., Revo Electric Co., Ltd., and Simplex Electric Co., Ltd.

Engineering Training

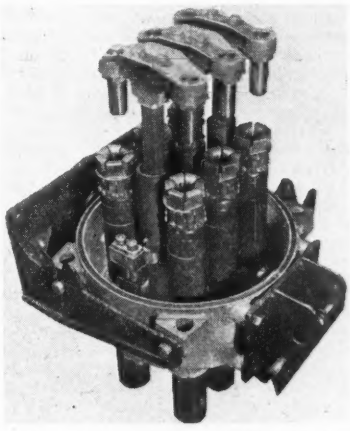
Leaflet P.L. 82 issued by the Ministry of Labour and National Service gives particulars of the conditions and allowances applying to men and women who undergo training in engineering employers' workshops. Copies of this and other relative leaflets are obtainable from any Employment Exchange.

Rolling Mill Switchgear

An interesting contract was executed recently by Ferguson Pailin, Ltd., for switchgear to control a large number of motors in a new continuous strip steel rolling mill. The mill demand has grown to such proportions that a duplicate supply is now taken directly from the grid to supplement the private generating plant, and power is utilised on the bigger drives at 2,200 V where the available short-circuit power approximates to 100 MVA.

The main motor control and distribution switchboard now consists of twenty-five all utilising type "BRL 4" circuit breakers rated at 100 MVA for 2.2 kV service and fitted with spring-closing operating mechanisms. Eight panels dealing with the incoming supplies are of the cubicle type with standby busbars and have hand-wheel operated knife switch type off-load busbar selectors. The outgoing panels are of the metalclad, single-busbar type and control motor units of high capacity.

To minimise unnecessary interruptions in supply the whole board is equipped with definite time delayed under-voltage release controlled by a master relay, the individual circuit breakers having DC under-voltage release mechanisms incorporated. Short-circuit protection is provided on each



The interior of a Ferguson Pailin "BRL" circuit breaker

circuit by overcurrent coils with time limit fuses and earth fault protection by instantaneous trips, all of which are directly connected on the circuit breaker mechanism. The motors are protected against overload, however, by thermal devices mounted on the motor carcases.

Had this particular scheme been attempted on low-voltage distribution the switchgear problems would have presented very considerable difficulty owing to the much heavier short-circuit currents which would have been encountered.

Overcharge for a Torch

At Woolwich on January 21st J. & F. Stone Lighting & Radio, Ltd., were summoned for selling a No. 8 torch battery for a halfpenny more than the price stipulated by the Battery Prices Order at their Hare Street, Woolwich, branch. A fine of £10, with three guineas costs, was imposed.

Copper from the Congo

It was announced last week by the Foreign Office that the principal feature of a Purchase Agreement relating to the Belgian Congo was an undertaking by the British Government to purchase 126,000 metric tons of copper.

Emergency Supplies to Local Authorities

The Ministry of Health recently gave local authorities instructions regarding the purchase of necessaries for homeless persons who are in need following the loss of their possessions owing to enemy action. Arrangements have now been made to prevent such action by local authorities from being impeded by the Limitation of Supplies Orders. No difficulty should arise where the local authority purchases goods direct from the manufacturers or wholesalers who are registered under the Orders. The authority may, however, make its purchases from local retail shops and in such a case the retailer, bearing in mind the needs of his ordinary customers, may desire to obtain an immediate replacement of the goods supplied to the authority. In order that the Limitation

Orders shall not prevent this, the Board of Trade has extended the concession mentioned above to cover not only goods supplied direct by the registered suppliers to the local authority, but also goods supplied to shops in replacement of goods sold by the shop to a local authority. All that will be necessary is for the shopkeeper to furnish the manufacturer or wholesale supplier with a certificate from the local authority that specified goods have been supplied to the authority for use by the authority.

Co-operation Between Retailers

Most retailers are aware that stocks of controlled goods destroyed by enemy action can be replaced without regard to the restrictions imposed by the Limitation of Supplies Orders. The Board of Trade is now urging them to make arrangements without delay for the marketing of a portion of these replacement stocks by other retailers in the event of their own premises being destroyed or if alternative premises are not available or if their acquisition is likely to be delayed. Unless this is done, besides the retailers running the risk of loss of trade, there is also a danger that consumers, who would normally rely on the bombed shops, will go short of essential supplies.

Chambers of Commerce and other trade organisations throughout the country should in the interests of the community and of their members arrange schemes of co-operation immediately and not wait until the bombs have fallen. An arrangement of the kind, sponsored by the Southampton Chamber of Commerce, is now being operated on a large scale by the traders of Southampton. Traders whose stocks have been destroyed have surrendered replacement rights to the value of several thousands of pounds, and on the basis of this surrender the Board of Trade has licensed a score of retailers whose premises are intact, to obtain immediate additional supplies.

American Electrical Exports

During the first ten months of 1940 the value of electrical equipment exported from the United States was $11,090,802, which was 27·3 per cent. above the total for the corresponding period of the preceding year. During October exports of rubber-covered wire reached a very low level. On the other hand shipments of DC generators in October were equal to those for the whole of the preceding nine months. Another item showing a substantial gain was self-contained lighting sets.

Blackstone Engines for Australia

To cope with the demands of its rapidly increasing population, Port Macquarie, Australia, has installed a new power station with a plant comprising two six-cylinder Blackstone Diesel engines, each developing 240 BHP, and one three-cylinder 120-BHP unit. The engines are of the latest totally-enclosed design, and are direct coupled to alternators with a combined output of 500 kW.

Post Office London Directory

In compiling the previous edition of this directory the publishers were called on to meet a number of unprecedented difficulties created by the evacuation of business firms from London on the outbreak of war. These difficulties, however, were small as compared with those met with in producing the 1941 (142nd annual) edition, since on this occasion the publishers were called upon to deal with a City continually subject to air attack. None the less the directory has appeared at its usual time and almost in its usual form.

The policy of showing in the commercial alphabetical section the emergency addresses of the offices of firms who have moved temporarily from London has been continued. There are also a number of cases where firms have moved certain departments of their business from their London offices and these also have been dealt with in this edition.

The price of the directory in spite of the much higher costs of production remains at 60s. The publishers are Kelly's Directories, Ltd., 186, Strand, London, W.C.2.

Non-standard Plugs

In the House of Commons on January 22nd Mr. Woodburn asked the Minister of Transport whether he was aware of the serious waste caused to industry and householders in this country by manufacturers of electric plugs adopting different gauges which prevented interchange; and whether he was prepared to fix standards for 5-A, 10-A, 15-A, &c., plugs so that all plugs and sockets would be interchangeable.

Mr. Montague, the Under-Secretary, said that all British manufacturers, except one, were now concentrating on the manufacture of plugs to British Standard Specifications. The manufacture of non-standard plugs could not be entirely stopped without grave inconvenience, but the amount of material involved was small.

Aluminium Alloys

An addendum to its book, "Chemical Analysis of Aluminium and its Alloys," has been prepared by the British Aluminium Co. Ltd. (Oakley Manor, Belle Vue, Shrewsbury), from which copies are obtainable. In this the company has tabled its procedure in connection with the free-cutting aluminium alloy B.35, which is now included among the light alloys for which analysis can be standardised.

Certified Flame-proof Gear

The customary quarterly schedule of mining and industrial equipment in respect of which certificates of flame-proof enclosure were granted during the three months ended December 31st, 1940, has been issued. At the request of the B.E.A.M.A. a few copies of these quarterly lists can be purchased at 1s. 2½d. (post free) from the Mines Department, Temporary Office Buildings, Heyhouses Lane, Lytham St. Annes, Lancs.

Purchase Tax Inquiries

Inquiries to the head office, H.M. Customs & Excise, regarding Purchase Tax should in future be addressed to the Secretaries, H.M. Customs & Excise, City Gate House, 39-45, Finsbury Square, London, E.C.2 (telephone: Bishopsgate 6550).

I.E.E. Western Centre

The Institution of Electrical Engineers (Western Centre) is holding a luncheon and its ordinary general meeting on February 10th at the Berkeley Café, Queen's Road, Bristol.

Calendars

A useful feature of the calendar received from the American Insulating Machinery Co. is that each sheet shows the preceding and following, as well as the current months.

Barber Switchgear Co. has sent us a desk calendar with monthly sheets.

New Catalogues and Lists

Metropolitan Electric Supplies, 2, Marshall Row, Brighton.—Leaflet announcing wholesale prices of British made porcelain connectors, single and multiway.

B.E.N. Patents, Ltd., High Wycombe, Bucks.—A leaflet giving particulars of the new "P 3" portable spray painting unit.

B.I. Spitfire Fund

In September last, a fund was opened by the employees of British Insulated Cables Ltd., for the provision of a "Spitfire" for the nation, the company subscribing an amount equal to the total subscribed by the employees. So enthusiastic was the response that a cheque for £5,000 was forwarded to the Ministry of Aircraft Production within a few days of the fund's inception. The B.I. Fund has now closed with a total of £6,148, and a cheque for £1,148, being the balance, has now been forwarded to Lord Beaverbrook.

Changes of Address

The Baldwin Instrument Co., Ltd., has moved to Farringdon Road, Cumnor, near Oxford (telephone: Cumnor 236 and 237).

Ensign Lamps, Ltd., has reopened its London depot at 98-100, Blackfriars Road, London, S.E.1. The telephone number is unchanged.

The Electrical Industries Benevolent Association announces the following changes of address of honorary collectors:—Manchester: Miss E. L. Wilson, c/o Barber & Coleman, Marsland Road, Brooklands, Sale, Manchester. Liverpool: Mr. F. Ridout, 100/102, Bold Street, Liverpool. Southampton: Mr. L. Holt, c/o Mr. H. Miller, Bickford, Otterbourne Hill, Chandler's Ford, Hants. Bristol: Mr. F. R. Ashmead, Haslam & Stretton, Ltd., 227, Stapleton Road, Bristol.

Mortimer, Gall & Co., Ltd., inform us that their accounts, costing, correspondence, filing, drawing office and No. 2 stores departments have been moved to "Millfield," Lovibonds Avenue, Farnborough, Kent. (Telephone: Farnborough, Kent, 828). The operative side of the business is still at 115–117, Cannon Street, London, E.C.4.

As from to-morrow the registered office of Dacier, Ltd., will be at 22, Bargates, Christchurch, Hants, while its factory will be transferred to Apex Works, Avenue Road, Christchurch.

Electric Transmission, Ltd., has moved to Etruria, Stoke-on-Trent (telephone, Stoke-on-Trent 2201/2; telegrams, Trission, Stoke-on-Trent).

TRADE MARK APPLICATIONS

AMONG recent applications for British trade marks are the following, objection against which may be entered within one month from January 22nd:—

GOLDEN SPRAY and SILVER SPRAY. Nos. 612,975 and 612,976 respectively. Class 9 (IV). Electric arc welding apparatus and electric arc welding electrodes. The Quasi-Arc Co., Ltd., Grosvenor House, Park Lane, London, W.1.

RAYMAX. No. B613,254. Class 10 (IV). X-ray apparatus. The Metropolitan-Vickers Electrical Co., Ltd., Number One, Kingsway, London, W.C.2.

IOTA. No. 612,955. Class 11 (IV). Electric lamps (other than for surgical or curative purposes) and electric light fittings. The Kego Electric Co., Ltd., West Lodge Works, The Green, Ealing, London, W.5.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following:—

MEGOMETER (formerly Electrical Equipment & Carbon Co.).

ELECTRICITY SUPPLY

Morley Showroom Decision. Sussex Mutual Aid Group. Wallasey Concession.

Chester. — SHELTER LIGHTING. — Mains lighting is to be provided in communal shelters at a cost of £1,500, and in school shelters at a cost of £1,493.

TARIFF REVISIONS.—The Corporation Electricity Committee has decided to amend the lighting charges in Area No. 2 to provide for a basic rate of 7.2d. for the first 1,000 kWh, with a reduction according to the energy supplied for lighting above that amount proportionate to the reductions contained in the city tariffs for lighting for general use. A similar concession is made for Area No. 3. Furthermore, in view of the change in time of the peak demand, it has been decided that under "restricted" supplies, energy may not be taken between 8 and 10 a.m. or alternatively 3.30 and 6 p.m. on any day in January, February, November and December, according as the peak load occurs between those hours respectively as to which the decision of the electrical engineer shall be final.

Clitheroe.—SUPPLY TO HORTON.—The Electricity Committee recently received an application for supplies for industrial purposes at Horton. It has now been agreed that the supply shall be furnished by Settle Electricity Co. for a reasonable period, allowing Clitheroe an opportunity for reconsideration at a later date.

Dublin.—X-RAY EQUIPMENT.—A vertical fluoroscope and other fittings for X-ray apparatus are to be installed by the Town Council at the Tuberculosis Dispensary in Charles Street West.

Durham.—SCHOOL LIGHTING.—Subject to the approval of the Board of Education the County Education Committee is to install electric lighting at East Howle Council School at a cost of £255.

Felling-on-Tyne. — SCHOOL LIGHTING. — The Education Committee is considering the installation of electric lighting at Windy Nook School in connection with A.R.P. work.

Great Yarmouth.—INQUIRY INTO CHARGES. —The Electricity Committee has instructed the electrical engineer to report with regard to charges in view of the decline in revenue due to evacuation and further increases in the cost of production.

Hull.—WIRING CHARGES.—As a wartime measure future wiring of electrical installations for hired cookers and other appliances is to be paid for by the hirer.

Ilford.—SHELTER HEATING.—An estimate of £7,500 from the electrical engineer for heating shelters has been referred by the Corporation Emergency Committee to the Regional Commissioner.

Llandudno.—APPEAL TO CONSUMERS.—Owing to the present demand for electricity and to delay in the delivery of certain equipment, the Electricity Committee has authorised the electrical engineer to issue an appeal to consumers temporarily to reduce by 50 per cent. their consumption of electricity for heating purposes. The engineer has also been asked to submit to the next meeting of the Committee recommendations for dealing with the present demand for electricity.

London.—HACKNEY.—The Borough Treasurer has reported that there is an uninvested balance of £18,133 in the Electricity Department's reserve fund. The Civil Defence and Finance Committee recommends that an amount of £15,994 shall be advanced from the fund for the ordinary purposes of the undertaking including the cost of sub-station sites, buildings and plant and mains. Interest at 3½ per cent. will be paid to the fund and repayment will be made by annual instalments.

In March, 1939, the Electricity Commissioners sanctioned the expenditure of £20,000 for the provision of vertical mains but the sanction was cancelled on the outbreak of war. Later the expenditure of £12,000 was approved and now the Electricity Committee recommends that application shall be made to the Commissioners for sanction to spend a further £5,000 for this purpose.

HAMMERSMITH.—Upon the report of the chief electrical engineer the Borough Council Emergency Committee has agreed, subject to the approval of the Regional Headquarters, to the provision, at an estimated cost of £100, of ventilation for the shelters at the Town Hall used for sleeping purposes.

The concession to consumers under which no claim is made for electrical apparatus on hire-purchase destroyed by enemy action is to be extended to cover wiring on hire-purchase.

ISLINGTON.—Owing to war conditions the Borough Council Electricity Committee has agreed to the granting of a Fringe Order to the County of London Electric Supply Co., Ltd., to afford supply to premises of the British Drug Houses Ltd.

ST. PANCRAS. — The Electricity Committee has arranged terms for stand-by supplies to the Camden and St. Pancras goods stations.

Sanction is being sought to borrow £2,218 for meters.

Morley.—SHOWROOMS TO REMAIN OPEN.—At a meeting of the Corporation Electricity Committee, Mr. N. Hunter, the borough electrical engineer and manager submitted a detailed report on the advisability of keeping the electricity showrooms open. He stated that a review of the showrooms' activities during the past twelve months showed that the first complete war year, whilst it has greatly altered the character of the showroom work, had not notably lessened its scope, and the development of the public relations side of the work which had taken place had demonstrated forcibly the indispensable character of the service which the showrooms could render to consumers in war as in peace. During 1940 the number of inquiries received was 4,000, and as a direct result of the showrooms' activities 196 cookers, 193 radiators, 117 irons, 119 kettles, 63 water heaters, 43 vacuum cleaners, and 40 other appliances were installed, representing an increased consumption of 300,000 kWh. The hire-purchase scheme had suffered and this explained the reduced turnover. On the other hand, the demand for electrical appliances through the simple hire scheme was actually on the increase and applications were being dealt with in rotation as supplies were limited on account of wartime restrictions.

Another important activity was the collaboration with the Ministry of Information and the Ministry of Food, whereby the window display campaign and the wartime cookery demonstrations had contributed to the war effort. The Committee decided that the showrooms should be carried on as usual.

Northwich.—FRINGE ORDER.—The Mid-Cheshire Electricity Supply Co., Ltd., is seeking a Fringe Order to supply electricity in connection with the joint water scheme of the Northwich Urban and Rural District Councils.

Norwich.—SCHOOL SHELTER HEATING.—A scheme providing for the electrical heating of all the school air-raid shelters in the city has been prepared by the City Council and submitted to the Board of Education, which is being asked to pay a 100 per cent. grant.

Redcar.—MUTUAL ASSISTANCE SCHEME.—The Town Council has adopted a recommendation of the Electricity Committee to co-operate in a mutual assistance scheme with the undertakings at Guisborough, Skelton and Eston in the event of war damage.

Scotland.—CALEDONIAN POWER SCHEME. —In the House of Commons last week Mr. Gibson asked the Prime Minister whether the Government would now take steps to put into operation the Caledonian Power Scheme.

Mr. Churchill replied in the negative. He said that the undertaking would take some years to put into operation and it was necessary to concentrate our energies on schemes offering a quicker return.

Stalybridge. — CHARGES FOR DAMAGED PREMISES.—The Stalybridge, Mossley, Hyde and Dukinfield Joint Electricity Board has decided to waive the payment of fixed charges under the two-part tariff and also the instalments on hire-purchase of apparatus in the case of premises rendered uninhabitable by enemy action for a period of not less than a week.

Stockton-on-Tees.—ELECTRIC LIFT.—The Town Council is to spend £959 on the installation of an electric lift at the quay warehouse.

Sussex.—MUTUAL AID SCHEME.—In June last we reported that Northern Sussex electricity undertakings had formed a mutual aid group. This scheme has now been extended by the merging of the Northern Sussex and South Coast groups. The member undertakings are as follows:—Brighton Corporation; Central Sussex Electricity, Ltd.; Eastbourne Corporation; East Grinstead U.D.C.; Horsham U.D.C.; Hove Corporation; Lewes & District Electricity Supply Co., Ltd.; Peacehaven Electric Light & Power Co., Ltd.; Ringmer & District Electricity Co., Ltd.; Shoreham & District Electric Lighting & Power Co., Ltd.; Sussex Electricity Supply Co., Ltd. (Crawley & Littlehampton); and Worthing Corporation.

The new group is operating under the title of the Sussex Electricity Undertakings Pool, and provides for assistance in the county over an area of 850 sq. miles. The chairman is Mr. H. Dixon (Central Sussex) and the vice-chairman is Mr. M. Mortimer (Worthing).

Tredegar.—DEARER ELECTRICITY.—Electricity tariffs are to be increased from 20 to 25 per cent.

Wallasey.—LIGHTING CHARGE CONCESSION.—In common with other Merseyside undertakings the Electricity Committee proposes to reduce the lighting charge from 3½d. to 1d. per kWh for electricity consumed in excess of that used in the corresponding quarter of last year due to the compulsory use of electric lighting in daytime because of boarded-up windows resulting from enemy action. A similar rebate amounting to approximately two-thirds will also apply to prepayment meter consumers.

Wantage.—PUMPING PLANT CONVERSION. —The Rural District Council is recommended to approve the conversion of the pumping plant at Hendred to electrical operation at an estimated cost of £600.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1938

6915. "Electric discharge tubes." N. S. Oerensofi. March 20th, 1939. (531239.)

23121. "Splicers, splicing ears and anchor tips for grooved electric trolley wire." R. Livingstone and Anti-Attrition Metal Co., Ltd. September 7th, 1939. (531314.)

1939

10004. "Electrical starting systems for internal combustion engines." Carter Carburettor Corporation. April 15th, 1938. (531244.)

12636. "High-frequency electron tubes, and a method of reducing grid loss therein." Board of Trustees of Leland Stanford Junior University. May 24th, 1938. (531247.)

15432. "Tuning devices for wireless receivers." General Electric Co., Ltd., and W. H. Peters. May 24th, 1939. (531248.)

16034. "Electrical convertors, particularly convertors operating at high frequencies." Board of Trustees of Leland Stanford Junior University. June 18th, 1938. (Addition to 523712.) (531251.)

16137. "Device for protecting alternating current apparatus against overload." Electrical Apparatus Co., Ltd., and R. H. Barbour. June 1st, 1939. (531392.)

18544. "Electric circuits especially for reproduction of multi-coloured subjects." Kodak, Ltd. June 25th, 1938. (531262.)

18708. "Apparatus for measuring the loss angle of dielectrics." T. R. Warren. June 27th, 1939. (531477.)

18837. "Electric communication systems." Telephone Manufacturing Co., Ltd., and L. H. Paddle. June 28th, 1939. (531318.)

18887. "Control apparatus for effecting sequential operation of power operated devices." Watford Electric & Manufacturing Co., Ltd., and H. Coates. June 28th, 1939. (531319.)

18917. "Electric lamps." G. W. Rawlings. June 29th, 1939. (531185.)

18960. "Control systems for radio receivers or other electric wave apparatus." Philco Radio & Television Corporation. July 20th, 1938. (531187.)

18961. "Control systems." Philco Radio & Television Corporation. July 20th, 1938. (531188.)

18962. "Electromagnetically operated step-by-step devices." Philco Radio & Television Corporation. July 20th, 1938. (531189.)

18963. "Electric impulse sending device." Philco Radio & Television Corporation. July 20th, 1938. (531190.)

18964. "System and method for transferring electric control signals." Philco Radio & Television Corporation. July 20th, 1938. (531191.)

18973. "Traversing devices for use in winding cables." Compagnie Générale d'Electricité. August 3rd, 1938. (531265.)

19075. "Electric condensers and methods of making same." Marconi's Wireless Telegraph Co., Ltd. June 30th, 1938. (531266.)

19076. "Electron-discharge devices." Marconi's Wireless Telegraph Co., Ltd. June 30th, 1938. (531200.)

19091. "Tools for recessing the ends of electric cables preparatory to sealing." Pyrotenax, Ltd., and G. D. Clothier. June 30th, 1939. (531201.)

19112. "Radio direction finders." Standard Telephones & Cables, Ltd., and C. W. Earp. June 30th, 1939. (531204.)

19115. "Telecommunication exchange systems." Standard Telephones & Cables, Ltd. (L. B. Haigh, E. J. Rousseau and P. J. Clemens.) June 30th, 1939. (531205.)

19210. "Monocyclic networks for transforming between constant voltage and constant current in alternating current circuits." British Thomson-Houston Co., Ltd. July 1st, 1938. (531393.)

19448. "Holders for piezo electric devices." E. L. Gardiner, and Simmonds Development Corporation, Ltd. July 4th, 1939. (531268.)

19722. "Insulating material." British Thomson-Houston Co., Ltd. July 8th, 1938. (531270.)

19870. "Electrical coils." British Thomson-Houston Co., Ltd. July 8th, 1938. (531272.)

19932. "Insulated electric conductors." British Thomson-Houston Co., Ltd. July 8th, 1938. (531273.)

20130. "Electrical communication system." Electrical Research Products, Inc. July 19th, 1938. (531394.)

20201. "Contact members for electrical switchgear." Research Engineers, Ltd., G. C. Goodhart, W. S. Gladstone and W. R. Matthews. July 11th, 1939. (531396.)

20418. "Electric modulating arrangements comprising an electron multiplier." General Electric Co., Ltd., and D. C. Espley. July 13th, 1939. (531219.)

20535. "Electric signalling systems." Siemens Bros. & Co., Ltd., D. A. Christian and E. W. Durkin. July 14th, 1939. (531216.)

20541. "Television transmitting apparatus." General Electric Co., Ltd., and D. C. Espley. July 14th, 1939. (531220.)

20573. "Air- and gas-tight wall lead-through for electric wiring systems, particularly in high altitude aircraft." S. F. Warren. (Henschel Flugzeug-Werke Akt.-Ges.) July 14th, 1939. (531228.)

20626. "Systems for modulation of radio frequency currents with carrier suspension." Intercontinental Service Corporation. July 18th, 1938. (531274.)

20629. "Internally ventilated small electric motors." R. Bosch Ges. July 18th, 1938. (531276.)

20632. "Method of forming a row of electrical contacts between opposite sides of a plate of glass." International Television Corporation, Ltd., P. Nagy, M. J. Goddard, and D. H. Byron. July 15th, 1939. (531277.)

20671. "Electric plug-and-socket couplings." Wandsworth Electrical Manufacturing Co., Ltd., and T. Batchelor. July 17th, 1939. (531281.)

20738. "Lighting control in dependence upon projected images." British Thomson-Houston Co., Ltd., and D. J. Mynall. July 17th, 1939. (531295.)

20796. "Furnace control." British Thomson-Houston Co., Ltd. July 20th, 1938. (531301.)

20837. "Impulse senders of the type used in telephone systems." General Electric Co., Ltd., A. A. Chubb and L. Wheatcroft. July 18th, 1939. (531305.)

20841. "Television receivers." Scophony, Ltd., and A. H. Rosenthal. July 18th, 1939. (531306.)

20843. "Caps and sockets for two-ended electric lamps." General Electric Co., Ltd., C. G. Eden, and N. L. Harris. July 18th, 1939. (531307.)

20855. "Control of heating plants of space heating systems." Landis & Gyr Akt.-Ges. April 8th, 1939. (531330.)

20870. "Wave filter." Standard Telephones & Cables, Ltd. September 24th, 1938. (531336.)

20878. "Electric power cables." Standard Telephones & Cables, Ltd. July 20th, 1938. (531338.)

20887. "Machine for electrically heating metal bars and tubes." Soc. Anon. Louvroil Montbard Aulnoye. July 27th, 1938. (Cognate application 20888/39.) (531339.)

20891. "Mercury-vapour electric discharge tubes with an external fluorescent coating." Soc. Anon. pour les Applications de l'Electricité et des Gaz Rares Etablissements C. Paz et Silva. April 7th, 1939. (531340.)

20890. "Protective means for elastic-fluid turbines." British Thomson-Houston Co., Ltd. July 21st, 1938. (531355.)

21051. "Current core with a magnetic shunt for induction-measuring-apparatus." Landis & Gyr, Akt.-Ges. May 11th, 1939. (531367.)

21060. "Electrically heated cooking and like apparatus." Tubes, Ltd., and J. P. Reed. July 20th, 1939. (531371.)

21064. "Prepayment meters for electricity." Sodeco, Soc. des Compteurs de Genéve. July 22nd, 1938. (531402.)

21097. "Electric junction boxes." Rediffusion, Ltd., and J. S. Newall. July 20th, 1939. (531372.)

21101. "Automatic control apparatus for polyphase regulating transformers." British Thomson-Houston Co., Ltd. July 22nd, 1938. (531373.)

21102. "Electric motors." British Thomson-Houston Co., Ltd. July 23rd, 1938. (531374.)

21103. "Apparatus for presenting cylindrical beads or pellets successively in a predetermined attitude." British Thomson-Houston Co., Ltd., and A. W. Buckland. July 20th, 1939. (531375.)

21118. "Galvanic dry cell." H. G. C. Fairweather. (Burgess Battery Co.) July 20th, 1939. (531379.)

21123. "Telegraph apparatus." Cable & Wireless, Ltd., and F. Warburton. July 20th, 1939. (Addition to 516373.) (531404.)

21150. "Carrier-wave transmission systems." F. C. McLean. July 20th, 1939. (531382.)

21152/3. "Wireless receivers." Philips Lamps, Ltd. July 23rd, 1938. (531405/6.)

21228. "Driving means for the batch rollers of jigger dyeing-apparatus." British Thomson-Houston Co., Ltd. July 23rd, 1938. (531419.)

21249. "Current supply arrangement for telegraph transmitting apparatus." Standard Telephones & Cables. (L. Braem and J. Sobola.) July 21st, 1939. (531422.)

21252. "Mechanical couplings for the control of adjustable apparatus." Standard Telephones & Cables, Ltd., R. E. Pritchard and R. F. Jessop. July 21st, 1939. (531423.)

21253. "Volume control circuits in signal transmission systems." Standard Telephones & Cables, Ltd. August 10th, 1938. (531424.)

21254. "Carrier current transmission system." Standard Telephones & Cables, Ltd. September 28th, 1938. (531425.)

21276. "Electric fuses." Patentverwertungs Ges. Hermes. July 21st, 1938. (Cognate application, 21277/39.) (531429.)

21317. "Emergency stop switches for electrical apparatus." J. A. Crabtree & Co., Ltd., H. F. McLoughlin and W. E. Hill. July 22nd, 1939. (531434.)

(Continued on next page)

FINANCIAL SECTION

New Companies. Capital Returns. Debenture Charges. Bankruptcies and Liquidations. Reports and Dividends. Stocks and Shares.

Reports and Dividends

J. and E. Hall, Ltd., report a profit for the year to September 30th of £65,841, as compared with £59,826 for 1938-39. The balance is arrived at before charging £17,000 for income tax, which for the previous year required £11,000. The ordinary dividend for the year is maintained at 8½ per cent., less tax, and the balance carried forward is increased by £3,561 to £43,008.

The Mid-Wales Electric Power Co.—A meeting of holders of the 4½ per cent. mortgage debenture stock was to be held yesterday (Thursday), to pass a resolution postponing the instalment of interest payable on January 31st, and further half-yearly payments of interest which fall due prior to the end of the war, until twelve months after the termination of the war.

R. B. Pullin & Co., report trading profits for the year to October 31st of £85,644, as compared with £62,496 for the preceding year, and a net profit of £25,580 (against £33,230). The final dividend is 15 per cent., making 20 per cent. for the year (against 25 per cent.), general reserve receives £8,000 and £1,776 is carried forward (against £4,196 brought in).

The Burma Electric Supply Co., Ltd., reports a net profit for the year to July 31st of £10,084, as compared with £9,629 for the preceding year. Reserve receives £4,000 and the preference dividend requires £7,200. The balance carried forward is £8,058 (against £9,174 brought in).

The Yorkshire Electric Power Co. is paying a final dividend of 5 per cent., making 8 per cent. for the year (same).

J. & F. Stone Lighting & Radio, Ltd., are paying a first and final dividend of 5 per cent. for the year to June 30th (same).

New Companies Registered

Springvale, Ltd.—Private company. Registered January 9th. Capital, £100. Objects: To acquire the business of designers and makers of exhibition stands, manufacturers of, and dealers in, electrical appliances, &c., carried on by the Springvale Electrical Co., Ltd. (in liquidation), and to carry on the business of exhibition organisers, timber merchants, joiners, electricians, &c. Directors: G. E. P. Pollitzer, Sarum Lodge, Telegraph Hill, N.W.3; C. A. Collis, Bungalow, Melville Road, Sidcup, Kent; and S. G. Bingham, Burberry Close, Woodside Road, New Malden, Surrey. Registered office: 200, Gresham House, Old Broad Street, E.C.

Melton Metallurgical Laboratories, Ltd.—Private company. Registered January 15th. Capital, £1,000. Objects: To carry on the business of manufacturers of metallising solutions for dielectrics and other electrical purposes, or for decorative purposes, manufacturers of low-melting-point solders and flux, research workers, &c. Directors: C. T. Walmsley, 9, Spring Vale, Cippenham, Bucks; E. Ross, address not stated; and Mrs. M. A. Holden, 9, Spring Vale, Cippenham, Bucks.

Companies' Returns

Statements of Capital

Metropolitan Electric Cable & Construction Co., Ltd.—Capital, £150,000 in 120,000 ordinary shares of 10s., and 90,000 5½ per cent. cumulative redeemable preference shares of £1. Return dated June 13th, 1940. All shares taken up. £59,900 paid on 119,800 ordinary shares. £90,100 considered as paid on 200 ordinary and 90,000 preference shares. Mortgages and charges, nil.

Dubilier Condenser Co. (1925), Ltd.—Capital, £500,000 in 500,000 preference shares of 10s. and 5,000,000 ordinary shares of 1s. Return dated July 31st (filed September 9th), 1940. 200,000 preference and 1,539,375 ordinary shares taken up. £176,968 15s. paid. Mortgages and charges, nil.

M.K. Electric, Ltd.—Capital, £300,000 in 200,000 ordinary and 100,000 6 per cent. preference shares of £1 each. Return dated August 8th, 1940. All shares taken up. £768 paid. £299,232 considered as paid. Mortgages and charges, £6,600.

Colvern, Ltd.—Capital, £30,000 in 30,000 shares of £1 each. Return dated July 27th, 1940. All shares taken up. £2,500 paid. £27,500 considered as paid. Mortgages and charges, nil.

H. J. Electrical Services, Ltd.—Capital £1,000 in £1 shares. Return dated August 2nd, 1940. 750 shares taken up. £450 paid. £300 considered as paid. Mortgages and charges: Nil.

Liquidations

Henfrey (Electrical), Ltd., 113, Burnt Oak Broadway, Edgware.—Pursuant to Section 238 of the Companies Act, 1929, a meeting of the creditors was held on January 20th when an approximate statement of affairs was submitted showing ranking liabilities of £450, whilst, after allowing £62 for preferential claims, there were assets of £250. A resolution was passed confirming the voluntary liquidation of the company with Mr. A. Stringer, of 26, Charing Cross Road, London, W.C., as liquidator.

Edgware and Stanmore Electrical Co., Ltd.—Particulars of claims by January 31st to the liquidator, Mr. F. J. L. Willey, 227, Holland Park Avenue, London, W.11.

Bankruptcies

H. J. Gill, 10, High Street, Keynsham, Somerset, electrical engineer and radio dealer.—This debtor's public examination was held recently, when the statement of affairs disclosed ranking liabilities of £777, with assets estimated to realise £117, leaving a deficiency of £659. The failure was attributed to want of capital and insufficient profits to meet overhead expenses. The examination was closed.

E. E. Garfield, electrician, 49, Ormond Street, Aston, Birmingham.—Last day for receiving proofs for dividend February 5th. Trustee, Mr. R. K. Clark, 37, Temple Street, Birmingham 2, Official Receiver.

H. J. Brownhill, electrical engineer, carrying on business at the back of 48, Whitehouse Street, Walsall.—Last day for receiving proofs for dividend February 7th. Trustee, Mr. R. K. Clark, 37, Temple Street, Birmingham, Official Receiver.

J. N. Hogg, electrical engineer, 104, Allerton Road, and 16, Woolton Street, Woolton, Liverpool.—First and final dividend of 4¼d. in the £, payable February 3rd, at 5, Rumford Place, Liverpool.

L. Spain (Len Spain & Co.), radio and electrical engineer, 376, Bearwood Road, Smethwick.—First and final dividend of 2s. in the £, payable February 6th, at 37, Temple Street, Birmingham 2.

A. Burnham (Briardale Radio Services), electrical engineer, 121, Oak Lane, Bradford.—Trustee, Mr. W. F. Cresswell, 71, Manningham Lane, Bradford, released January 11th.

E. C. Johnson and **J. A. Sheward** (Edstan Electric), 20, Market Street, Hanley, Stoke-on-Trent, and at Newcastle-under-Lyme.—First and final dividend of 8¾d. in the £, payable January 28th, at 12, Lonsdale Street, Stoke-on-Trent.

New Patents (*Concluded from page 328*)

21327. "Purification of mercury in connection with plant in which mercury is used." British Thomson-Houston Co., Ltd. July 23rd, 1938. (531436.)

21408. "Ultra short wave apparatus." Marconi's Wireless Telegraph Co., Ltd. August 19th, 1938. (531454.)

21417. "Method and means for demonstrating electrical apparatus, experiments and phenomena." C. W. Hansel. July 24th, 1939. (Cognate application, 24983/39.) (531455.)

21475. "Pre-set tuning devices for radio receiving apparatus." Philips Lamps, Ltd. July 25th, 1938. (531494.)

21476. "Radio receivers comprising a chassis and a tuning condenser mounted thereon." Philips Lamps, Ltd. July 27th, 1938. (531495.)

21479. "Apparatus for detecting the passage of a vehicle." Siemens & General Electric Railway Signal Co., Ltd., and C. C. Mayne. July 24th, 1939. (531496.)

21502. "Electrolytic recording particularly in facsimile telegraphy." H. J. C. Forrester. (Radio Inventions, Inc.) July 24th, 1939. (531501.)

21545. "Power multiplier." Farnsworth Television & Radio Corporation. August 3rd, 1938. (531508.)

21611. "Printing-telegraph receiver." Standard Telephones & Cables, Ltd. July 25th, 1938. (531519.)

21630. "Coating of conducting bodies by electrophoresis." General Electric Co., Ltd., and M. Benjamin. July 25th, 1939. (531522.)

21631. "Luminescent materials." General Electric Co., Ltd. (Patent-Treuhand-Ges. für Elektrische Gluhlampen). July 25th, 1939. (531523.)

21632. "Electric discharge devices with indirectly heated thermionic electrodes." General Electric Co., Ltd. (Patent Treuhand-Ges. für Elektrische Gluhlampen). July 25th, 1939. (Cognate application, 24825/39.) (531524.)

1940

2301. "Electrical primary cells." Alpha Accessories, Ltd., and W. G. Adie (Ray-O-Vac Co.). February 6th, 1940. (531237.)

2434. "Rheostatic braking systems for electric motors." English Electric Co., Ltd., W. E. M. Ayres and A. J. Riches. June 30th, 1939. (Divided out of 518476.) (Cognate application, 10749/40.) (531310.)

13475. "Apparatus for detecting minute potential difference in alternating current systems." T. R. Warren. June 27th, 1939. (Divided out of 531477.) (531538.)

STOCKS AND SHARES

TUESDAY EVENING.

THE cheerfulness and vitality shown by Stock Exchange markets a week or so ago, gave place to a more cautious sentiment upon recurrence of invasion talk that came from various quarters. There was nothing new about it, but in the wartime narrowness of Stock Exchange markets, it had the effect of restricting business and of imposing a check upon previous bullishness. Few of the recent gains secured by front-rank industrial shares have been surrendered. Where speculative investment has taken a hand, prices were disposed to react. After last week, when nearly fifty prices in our lists showed gains, it is surprising, in view of a general dullness in Stock Exchange markets, to find that some thirty prices are again better in to-day's electrical groups.

Home Railway Outlook

Home Railway stocks are mostly a little easier after their sharp rises; the buying movement which was recently a feature in this market has spent a good deal of its force. The dividend announcements are expected to be made on February 19th, when the Southern Railway will declare, it is assumed, dividends making 5 per cent. on the preferred ordinary and the 5 per cent. preference. The latter is of course assured; concerning the former, little doubt exists. London Passenger Transport "C" stock will, it is taken for granted, receive 1½ per cent. Even after the rises which have occurred in the stocks, the returns at these figures would be sufficiently tempting to stimulate further buying were it not for the uncertainty felt as to the forthcoming re-arrangement of terms which the Government proposes to make. On the bargain of last February, the Home Railway companies would be virtually assured of, at any rate, the fixed dividends on the stocks bearing specified rates.

One-Way Traffic of Costs

Various considerations have come into being since that bargain was concluded between the Government and the railways. Substantial rises in costs, etc., have scarcely been met by the two increases in fares. The strong probability of railwaymen reiterating their demand for a rise in wages is augmented by the latest arrangements in the shipping and engineering trades. Difficulties in operation have multiplied, and, what with one thing and another, the expense to the Government of meeting obligations incurred under last February's agreement are very heavy.

These are factors which make for caution in the mind of the investor who, were they absent, would be only too willing to pay the current prices for Home Railway stocks. London Passenger Transport "C" stock, as mentioned here some weeks ago, looks expensive by comparison with the junior stocks of the "Big Four," but in this case the price is kept steady by the expectation of better things to come, and at 34 it shows a gain of a point. Southern preferred at 51½ is down 1, after its recent dramatic advance.

Kentish Companies

The Kent Electric Power Company proposes to take into itself the South-East Kent Electric Power Co., Ltd., and the West Kent Electric Co., Ltd. All three belong to the County of London Electric group. The amalgamation is to be carried out through the medium of share exchanges. Of the West Kent's £1,000,000 capital, all but 3 per cent. is held by the South Metropolitan Electric Light and Power Company, one of the County of London Electric's subsidiaries. The South-East Kent Electric has a share capital of £250,000 in £1 shares, and of these 249,998 are held by the County of London Electric.

In these proposals some people think they see a hint that the County of London Electric Company desires eventually to bring under one head the various subsidiaries in which it holds the controlling interest. No doubt war conditions contribute to the intention. In the market, they think that the County Company will, by degrees, amalgamate into one group the subsidiaries to which it acts as a kind of sponsor. County ordinary shares have risen 1s. 9d. to 35s.

Electricity Supply

The Yorkshire Electric Power Co. has declared a final dividend of 5 per cent., making 8 per cent. for the year, the same as that for at least eighteen consecutive years. The price is unchanged at 35s. Newcastle Electrics are 2s. 6d. up at 25s., the North being a persistent buyer. Llanellys have put on 1s. at 19s. Bournemouths and London Electrics are both 1/16 up and Southern Areas advanced to 15s.

The Prevailing Anomaly

Discussion of the anomaly provided by simultaneous price-rises in gilt-edged fixed-interest securities, and in the ordinary shares of industrial companies, will take into account the artificial monetary conditions to which total war can contribute. Those conditions are governed by the fact that the Government of this country now exercises complete control over money rates. British war borrowing is fixed upon a 2½ to 3 per cent. basis. To this standard, all other rates automatically conform. It is artificial in the same sense as any controlled price is, when supply is divorced from demand. The ordinary shares of such front-rank companies as British Insulated, Callender's, General Electric, Henley's, Johnson & Phillips and others are, in spite of the dividends being liable to variation, gilt-edged in their own particular class.

The Rising Tide

Notwithstanding the dullness that has brought about reaction in a good many prices, the Manufacturing and Equipment list of quotations given overleaf is again showing a string of improvements. International Combustions are up another 5s. to 4⅝. General Electrics tread hard upon the heels of 80s. Gains of 1/16 make British Aluminium 42s. 6d., Cromptons 18s. 9d., Ever Ready 27s. 3d., Lucas 53s. 9d., Revo 18s. 9d., Westinghouse Brake 41s. 3d. Mather & Platt at 36s. 3d. have risen a florin, English Electric 1s. A. C. Cossor shares went from 5s. to 6s. in three days. Electric & Musical Industries at 8s. 3d. are 6d. better.

Buyers of Debenture Stocks

As affording practical illustration of the investment pressure to buy securities, no better evidence can be offered than the lists issued by Stock Exchange dealers who are buyers of numbers of debenture stocks at what look to be high price. Lists of stocks on offer are familiar enough in normal times. For stocks to be wanted, and for good prices to be offered, in war days, is, however, a matter that excites constant surprise among those concerned.

But here is another short selection of Home Electricity Supply debenture stocks that can be sold at prices which yield an average of less than 4 per cent. on the money, leaving out of account any redemption allowance. The following stocks are only eight out of a catalogue of twenty-four that are wanted, and to the latter, others could be added without difficulty. In practically every case, the amounts of stock required range from £2,000 to at least £5,000. The stocks are taken at random from the list issued by a well-known firm of Stock Exchange jobbers dealing in electricity supply stocks and shares:—

Company.	Interest per cent.	Price.
Bournemouth & Poole	3½	92
City of London	5	106
County of London	5	108
Edmundsons'	4	101
London Power	4	102
Midland Power	3½	92
Northmet Power	4	99
Yorkshire Electric	3½	85

Electricity Expansion

Amongst the many plans now contemplated in connection with reconstruction and reorganisation after the war, one that will very certainly play an important part concerns the need for greater electric power output. Parts of London suffered, some weeks ago, from temporary interruption to the gas supply. Tenants of offices and other consumers promptly asked for alternative electric service for radiators. To their surprise, some of the applicants were informed that the electricity supply undertakers could not provide, at the peak hours, enough current to meet all the requirements for power. People who needed no more than a small amount were able to take a supply from lighting circuits. Others, who wanted heat for larger premises, found they could not have it.

In these latter days, the more chilly mortals urged, there ought to be an abundant supply of electricity for power purposes both normally and in emergencies. The experience of the last few weeks will be quoted in support of such views, and in any comprehensive scheme for reconstruction in London, the needs of electricity users are bound to be prominently brought forward.

ELECTRICAL COMPANIES' SHARES

Prices, Dividends and Yields

Company	1940 High-est	1940 Low-est	Dividend Pre-vious	Dividend Last	Middle Price Jan. 27	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies							
Bournemouth and Poole ..	63/6	36/6	15	15	47/6	+⅛	—
British Power and Light ..	30/-	20/-	7	7	27/6	..	5 1 10
City of London	28/-	20/-	7½	7½	22/-	..	—
Clyde Valley	38/6	24/-	8	8	35/-	..	4 11 5
County of London	43/3	21/-	10½	10½	35/-	+1/9	6 0 0
Edmundson's :							
7% Pref.	32/-	24/3	7	*7	28/3	..	4 19 1
Ord.	27/6	18/6	9	6	24/6	..	4 18 0
Elec. Dis. Yorkshire ..	40/3	32/-	9	9	36/3	..	4 19 4
Elec. Fin. and Securities ..	42/-	34/6	12½	12½	40/-	..	6 5 0
Elec. Supply Corporation ..	48/-	39/-	12	11½	37/-	..	6 4 4
Isle of Thanet	16/-	5/6	4	4	6/-	..	—
Lancs Light and Power ..	33/-	21/6	7½	7½	28/9	..	5 4 4
Llanelly Elec.	21/-	17/-	5½	5½	19/-	+1/-	5 15 9
Lond. Assoc. Electric ..	21/-	12/6	7	5½	13/9	..	—
London Electric	35/-	19/-	8	7	21/3	+⅛	6 11 9
London Power Deb. Red. ..	105½	100	5	5	104½	+1	4 15 6
Metropolitan	41/6	22/6	12	10	33/9	..	5 18 6
Midland Counties	39/-	23/3	8	8	33/9	..	4 14 10
Mid. Elec. Power	40/-	29/6	9	9	33/9	..	5 6 8
Newcastle Elec.	29/9	22/6	7	7	25/-	+½	5 12 0
North Eastern Elec. : ..							
Ordinary	31/6	16/6	7	7	26/3	..	5 6 9
7% Pref.	32/6	25/6	7	7	31/3	+⅛	4 9 6
Northampton	44/-	38/-	10	10	40/-	..	5 0 0
Notting Hill 6% Pref. (£10)	10½	9	6	6	9	..	—
Northmet Power :							
Ordinary	42/3	22/6	10	10	33/3	..	—
6% Pref.	29/-	23/-	6	6	27/-	..	4 9 0
Richmond Elec.	24/6	18/-	7	6	18/9	..	—
Scottish Power	38/-	24/-	8	8	34/6	..	4 12 9
Southern Areas	21/3	12/9	5	5	15/-	+6d.	6 13 4
South London	23/3	20/-	7	7	20/-	..	7 0 0
West Devon	20/-	17/6	5	5	20/-	..	5 0 0
West Glos.	22/-	15/-	2½	4½	16/3	..	5 10 10
Yorkshire Elec.	40/-	23/6	8	8	35/-	..	4 11 5
Overseas Electricity Companies							
Atlas Elec.	4/-	1/3	Nil	Nil	2/-	+3d.	—
Calcutta Elec.	37/-	22/6	10*	8*	35/6	+6d.	4 10 2
Cawnpore Elec.	30/-	24/-	10	10	27/6	+⅛	7 5 6
East African Power ..	25/6	19/6	7	7	22/6	..	6 5 3
Jerusalem Elec.	24/-	15/-	7	7	21/3	+⅛	6 11 9
Kalgoorlie (10/-)	12/6	9/6	7½	7½	12/-	+6d.	6 5 0
Madras	26/9	21/6	8*	6*	25/-	..	—
Montreal Power	35½	30	1½	1½	32	..	—
Palestine Elec. "A" ..	25/-	10/-	5*	Nil	20/-	..	—
Perak Hydro-electric ..	20/3	13/-	2½	6	17/-	+9d.	7 1 2
Shawinigan Power ..	27½	19	83cts.	90cts.	18½	−½	—
Tokyo Elec. 6%	69	30	6	6	37	..	16 4 4
Victoria Falls Power ..	75/9	56/6	15	15	71/3	..	4 4 0
Whitehall Investments Pref.	17/9	8/-	7½	7½	13/6	..	11 2 2
Public Boards							
Central Electricity							
1950–70	110½	104	5	5	110	+1	4 11 0
1955–75	112½	106	5	5	111	..	4 10 1
1951–73	107½	102	4½	4½	106	+1	4 5 0
1963–93	96½	90	3½	3½	95	+1	3 13 6
1974–94	91	79½	3½	3½	88½	..	3 13 5
London Elec. Trans. Ltd.	92	87½	2½	2½	93	..	2 15 9
London & Home Counties							
1955–75	113½	105	4½	4½	105½	..	4 5 4
Lond. Passenger Transport :							
A	116	104	4½	4½	111½	..	4 0 9
B	116	102½	5	5	106	..	4 14 4
C	65½	25	1½	1½	34	+1	4 8 3
West Midland Joint Elec.							
1948–68	106½	103	5	5	105½	..	4 14 9
Telegraph and Telephone							
Anglo-Am. Tel. :							
Pref.	107	85	6	6	101xd.	..	5 18 10
Def.	23½	18	1½	1½	23½	..	6 7 8
Anglo-Portuguese	22/6	10/-	8	8	15/-	..	10 13 4
Cable & Wireless :							
5½% Pref.	99½	66	4½	5½	97½	−2	5 12 10
Ord.	65	27	4	4	57½	−1	6 19 2
Canadian Marconi $1 ..	6/-	4/-	Nil	4cts.	5/-	+6d.	—
Globe Tel. & Tel. :							
Ord.	32/6	21/6	7½*	6*	26/3	..	4 11 5
Pref.	27/9	22/6	6	6	26/3	+⅛	4 11 5
Great Northern Tel. (£10)	20	11	20	20	12½	..	—
Inter. Tel. & Tel.	5½	2½	Nil	Nil	3	..	—
Marconi-Marine	30/-	18/3	10	7½	22/6	+½	6 13 3
Oriental Telephone Ord. ..	2½	45/-	12*	11½*	2½	..	4 16 10
Telephone Props.	15/-	11/-	6	6	11/3	..	10 13 4
Telephone Rentals (5/-) ..	9/6	5/3	10	10	7/3	..	6 18 0

Company	1940 High-est	1940 Low-est	Dividend Pre-vious	Dividend Last	Middle Price Jan. 27	Rise or Fall	Yield p.c. £ s. d.
Traction and Transport							
Anglo. Arg. Trams:							
First Pref. (£5)	4/3	1/-	Nil	Nil	2/-	..	—
4% Inc.	11½	2	Nil	Nil	9	..	—
British Electric Traction :							
Def. Ord.	830	400	5	45	800	..	5 12 6
Pref. Ord.	169	130	8	8	150	−10	5 6 8
Bristol Trams	48/6	32/6	10	8*	38/9	+⅛	—
Brazil Traction	12½	5½	$1	50c.	7½	−½	—
Calcutta Trams	24/-	16/3	8	5½	19/-	..	5 15 4
Cape Elec. Trams.	18/6	16/-	5	5	17/-	..	5 17 8
Lancs Transport	35/-	27/6	10	10	35/-	..	5 14 3
Mexican Light :							
1st Bonds	36	25	5	5	35	..	—
Rio 5% Bonds	95	74	5	5	85	..	5 17 8
Southern Rly. :							
5% Prefd.	79	35	5	5	51½	−1	9 14 2
5% Pref.	104½	59	5	5	87	..	5 15 0
T. Tilling	45/9	29/-	10	10	41/3	..	4 17 0
Tilling & B.A.	47/6	41/9	9*	8*	44/6	..	—
West Riding	35/-	25/-	10	10	34/6	..	5 16 0
Equipment and Manufacturing							
Aron Electricity Ord. ..	17/6	10/-	15	Nil	16/-	..	—
Assoc. Elec. :							
Ord.	43/3	26/6	10	10	40/-	..	5 0 0
Pref.	36/6	32/3	8	8	35/-	..	4 11 5
Automatic Telephone & El.	47/3	32/-	12½	12½	45/-	..	5 11 1
Babcock & Wilcox ..	50/-	28/6	10	11	42/6	..	5 13 8
British Aluminium Ord. ..	56/-	29/-	12½	12½	42/6	−⅛	—
British Insulated Ord. ..	92/6	67/-	20	20	87/6	..	4 11 6
British Thermostat (5/-) ..	14/9	6/6	18½	18½	11/3	..	8 4 6
British Vacuum Cleaner (5/-)	12/-	4/9	40	12½	6/3	..	10 0 0
Brush Ord.	4/6	1/9	Nil	Nil	3/9	..	—
Callender's	69/-	46/-	15	15	65/-	..	4 12 4
Chloride Elec. Storage ..	72/6	55/-	15	15	62/6	..	4 16 0
Consolidated Signal ..	72/6	59/-	36½	17	65/-	..	5 4 7
Crabtree (10/-)	24/9	17/6	17½	17½	22/6	..	7 15 7
Crompton Parkinson :							
Ord. (5/-)	20/-	12/-	30	20	18/9	+⅛	5 6 8
E. K. Cole (5/-)	5/-	2/6	10	Nil	4/6	..	—
Elec. & Musical Industries							
(10/-)	10/3	4/3	5	Nil	8/3	+6d.	—
Electric Construction ..	36/3	27/6	13½	10	27/6	..	7 5 6
Enfield Cable Ord. ..	56/-	40/6	25	16½	50/-	..	6 10 0
Electrical Switchgear (10/-)	22/6	20/-	16	10	20/-	..	5 0 0
English Electric	33/9	16/6	10	10	30/-	+⅛	6 13 4
Ensign Lamps (5/-) ..	15/3	12/6	25	25	15/-	..	8 6 8
Ericsson Tel. (5/-)	39/3	23/-	25*	25*	32/6	..	—
Ever Ready (5/-)	28/3	16/6	30	40	27/3	+⅛	7 6 6
Falk Stadelmann	18/3	12/6	6	7	14/6	..	9 13 2
Ferranti Pref.	25/-	22/-	7	7	23/9	..	5 18 0
G.E.C. :							
Pref.	32/6	26/-	6½	6½	31/3	..	4 3 2
Ord.	83/3	53/3	20	20	79/3	+1/9d.	5 1 0
Greenwood & Batley ..	25/6	20/-	15	13	20/-	..	13 0 0
Hall Telephone (10/-) ..	18/6	8/9	15	10	11/3	..	8 18 0
Henley's (5/-)	21/6	12/6	20	20	20/-	..	5 0 0
4½% Pref.	21/3	20/6	4½	4½	21/3	..	4 4 8
Hopkinsons	46/9	32/6	15	15	38/3	..	7 16 10
India-Rubber Pref. ..	21/-	19/6	5½	5½	20/-	..	5 10 0
Intl. Combustion	121/3	70/-	33½	30	4½	+½	6 9 10
J. Lucas	60/6	40/-	15	15	53/9	+⅛	5 11 6
Johnson & Phillips ..	50/9	32/6	12½	15	47/6	..	6 16 4
Lancashire Dynamo ..	59/9	47/6	25	20	47/6	..	8 8 5
Laurence Scott (5/-) ..	11/-	6/-	15	15	7/-	..	10 14 2
London Elec. Wire ..	25/6	20/-	7½	7½	22/6	..	6 13 4
Mather & Platt	46/6	30/-	13½	10	36/3	+2/-	5 10 4
Metropolitan Elec. Cable Pf.	22/-	21/3	5½	5½	21/3	..	5 3 6
Murex	86/9	52/6	20	20	81/3	+⅛	4 18 3
Pye Deferred (5/-) ..	9/-	6/9	25	25	10/-	..	14 5 8
Revo (10/-)	20/9	11/6	17½	5	18/9	+⅛	2 13 4
Revrolle	60/6	41/-	12½	12½	47/6	..	5 5 2
Siemens Ord.	23/9	15/6	7½	7½	20/-	..	7 10 0
Strand Elec. (5/-) ..	2/3	9d.	4	2	1/9	..	5 14 4
S. Smith (1/-)	8/-	3/6	37½	50	7/6	..	6 13 4
Switchgear & Cowans (5/-)	11/9	5/6	20	10	8/9	+⅛	5 14 3
Telegraph Condenser (10/-)	8/9	6/3	5	..	7/6	..	—
Telegraph Construction ..	42/6	29/-	10	10	36/3	..	5 10 6
Telephone Mfg. (5/-) ..	9/-	5/-	9	9	7/-	..	6 8 7
Tube Investments	96/9	59/-	23½	23½	91/3	..	5 5 0
Vactric (5/-)	3/6	2/-	4	Nil	2/3	..	—
Vickers (10/-)	22/-	9/6	10	10	15/6	−3d.	6 9 0
Ward & Goldstone (5/-) ..	19/9	12/6	20	20	13/9	..	7 5 6
Westinghouse Brake ..	46/-	30/6	17½	10	41/3	+⅛	4 17 0
Walsall Conduits (4/-) ..	26/6	17/6	55	55	26/3	..	8 7 8
West, Allen (5/-)	7/-	3/-	7½	10	3/9	..	10 0 0

* Dividends are paid free of Income Tax.

CONTRACT INFORMATION

Particulars of work for which tenders are invited, contracts placed, and building schemes promising work for electrical contractors and traders

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), Millbank, Westminster, London, S.W.1.

Birkenhead.—February 7th. Electricity Department. E.h.v. metalclad switchgear, etc. (January 24th.)

Dundee.—February 12th. Electricity Department. Transformers for low-voltage lighting. (See this issue.)

Eire.—ARKLOW.—February 11th. U.D.C. Automatic booster plant with a capacity of 1,200 gallons per hour. Documents and particulars from P. H. McCarthy & Son, consulting engineers, 26, Lower Leeson Street, Dublin. (Deposit, £5 5s.). Tenders to the presiding chairman, c/o P. J. G. Bannon, Town Clerk, U.D.C. Offices, Courthouse.

Leeds.—February 14th. Electricity Department. Stores for twelve months. (See this issue.)

London.—KENSINGTON.—February 6th. Borough Council. Electrical goods (a) cables, flexibles, etc., and (b) conduits, fittings and accessories, for 12 months commencing April 1st. Form of tender from F. Webster, Town Clerk, Town Hall.

Luton.—February 10th. Borough Council. Installation of lighting in tunnel shelter. (See this issue.)

New Zealand.—WELLINGTON.—Post and Telegraphs Department. February 6th. Single-core power cable. (T.23550/40.)*
February 4th. Telephone cable. (T.15032/41.)*

South Africa.—PRETORIA.—February 12th, City Council. One or, alternatively two, 18,750-kW turbo-alternators and exciters, with condensing and auxiliary plant. (January 10th.)
February 17th. Ten three-panel l.v. switchboards. (T.15067/41.)*
February 20th. Electric cooking apparatus and refrigerator. (T.15032/41.)*
March 13th. Transformers, h.v. and l.v. switchgear. (T.15287/41.)*
PORT ELIZABETH.—March 13th. Municipality. One battery driven tower wagon and one battery driven van. (T.15013/41.)*
Electric lamps and cable conduit. (T.15014/41.)*
JOHANNESBURG.—Railways and Harbours February 10th. 25,000 yd. lead-sheathed, enamelled and d.c.c. cable; 8,000 yd. p.i.l.c. and armoured twin cable; 21,120 yd. p.i.l.c. and armoured cable, star quad; 2,000 yd. armoured cable lead sheathed, i.r., star quad; and 750 yd. cable, lead sheathed enamelled, silk and cotton covered. (T.15139/41.)*

Southern Rhodesia.—SALISBURY.—March 10th. City Electricity Department. 374 meters of various types. (T.23645/40.)*
March 10th. Electrical distribution material. (T.Y.15136/41).*
Stores Department. March 28th. Electrically-driven rendering vessel, etc., for municipal abattoir. (T.15135/41.)*

Stoke-on-Trent.—February 12th. Electricity Department. Mains and cables, e.h.v. substation switchgear and transformers. (January 24th.)

Tottenham.—February 14th. Borough Council. Electric lamps, Schedule No. 20. Forms of tender from E. Townson, Town Clerk, Town Hall.

Orders Placed

Barrow-in-Furness.—Public Assistance Committee. Accepted. Electrically-operated laundry machinery, Roose Institution (£2,294).—Thomas Bradford & Co.

Brighton.—Electricity Committee. Accepted. 33 kV oil circuit breaker (£8,566).—Metropolitan-Vickers Electrical Co.

London.—BATTERSEA.—Electricity Committee. Recommended for one year:—Meters.—Chamberlain & Hookham; Ferranti. Joint boxes, house service cut-outs and Cable.—Callender's. Disconnecting boxes, copper wire and insulating tape.—Henley's. Joint box compound.—Dussek Bitumen and Taroleum. Electrical wires for installation work.—Stearn Electric Co. Flexible wires and wiring accessories.—Wm. White & Co. Steel sheathing and fixing clips.—Wholesale Electric Co. Conduit and conduit fittings.—Sloan Electric Co. Switches and cooker control units.—J. A. Crabtree & Co. Ironclad cut-outs and switch fuses and ironclad splitters.—Foster Engineering Co. Cookers.—Jackson Electric Stove Co. Cookerettes.—Belling & Co. Water heaters.—Heatrae. Immersion heaters.—Santon. Irons.—Revo Electric. Kettles.—Bulpitt & Sons. Glassware.—Falk, Stadelmann & Co. Switchplugs.—T.M.C. (Harwell) Sales.

Nelson.—Electricity Committee. Accepted. Rhythmatic injection equipment (£1,038).—Automatic Telephone & Electric Co.

Walsall.—Public Assistance Committee. Accepted. Electric fires at Beacon Lodge (£460).—Truman Electrical Co.

Windsor.—Town Council. Accepted. Traffic control signals (£534).—Automatic Telephone & Electric Co.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ancoats.—Additions and alterations, Wenlock Arms, Oldham Road, Radium Street, and Portugal Street; manager.

Bacup.—Alterations, Park Hotel; Massey's Burnley Brewery, Ltd., Bridge End, Burnley.

Blackley.—Additions and alterations, Red Lion Hotel, Rochdale Road; manager.

Blyth.—Shelters at 21 schools (£16,000), for T.C.; borough engineer, Municipal Offices.

Brighton.—Bakery for C.W.S., Moulsecoomb Way; Bethell & Swannell, architects.
Alterations, Intermediate boys' school (£5,500); borough engineer.

Cardiff.—First-aid post, etc., for T.C.; G. H. Whitaker, city engineer, City Hall.

Croydon.—Rebuilding portion of Town Hall, for T.C.; E. Taberner, town clerk, Town Hall.

Dawley.—Fire station, for U.D.C.; surveyor, Council Offices.

Derby.—Premises and plant for treating household waste for pig food (£3,000), for T.C.; city engineer, Corporation Offices.

Devon.—Police stations, Torquay (£39,797), and Totnes (£14,980); county architect, 97, Heavitree Road, Exeter.

Gateshead-on-Tyne.—Warehouse for the Tyne-Tees Shipping Co., Ltd.; Hetherington & Wilson, architects, County Chambers, Westgate Road, Newcastle-on-Tyne.

Glasgow.—Proposed school at Pennilee Housing scheme, for Corporation; city architect.

Great Harwood.—Domestic communal shelters for 70 per cent. of population, for U.D.C.; J. H. Sutcliffe, Town Hall.

Hebburn-on-Tyne.—Canteen for Palmers (Hebburn) Co., Ltd.

Ilford.—Communal feeding centres; borough engineer.

Kent.—Central school, Cudham, near Orpington, for E.C.; W. H. Robinson, county architect, Maidstone.

Leicester.—Operating theatres and laboratory extensions, City General Hospital, for T.C.; city surveyor, Town Hall.

Lichfield.—Sewage pumping station, for R.D.C.; T. Moseley, clerk, Rural Council House.

Lincoln.—Building for deep X-ray treatment, Scunthorpe War Memorial Hospital, for T.C.; borough surveyor, Corporation Offices.

London (CHELSEA).—Repairs to dwellings at Macnamara House and Albert Gray House, Lacland Street and Riley Place; borough engineer's department, Town Hall, King's Road, S.W.3.
LEWISHAM.—Extensions, printing works, Silk Mills Path; J. C. Anderson.

Merthyr.—Nursery schools for evacuee children, for E.C.; borough engineer, Town Hall.

Morley.—Canteen and burling room, Hollow Top Mills, Bridge Street; Richardson & Co. (Leeds), Ltd.

North Riding.—Shelters at a further five schools for the E.C. (£7,600); county architect, County Hall, Northallerton.

Scarborough.—New works; William Dove, mason, Memorial Works, Filey. (Site being bought.)
Housing repairs (£6,400), for T.C.; town clerk, Town Hall.

Stafford.—Houses (68), Silkmore Estate (£41,320), for T.C.; W. Plant, borough surveyor, Borough Hall.

Stockton-on-Tees.—Warehouse with electric lift, for Pickerings, Ltd.

Stokesley.—Public shelters (£15,000), for R.D.C.; surveyor, Council Offices, High Street.

Sunderland.—Church, Springfield Farm Estate; Rev. R. Morrissey, P.P., St. Joseph's.
Showrooms, Holmside, for Wilkinson & Co.; W. and T. R. Milburn, architects.

Watford.—Maternity and child welfare centre, for T.C.; borough engineer, 14, High Street.

Weston-super-Mare.—Communal washing and bathing centre, for T.C.; borough surveyor, Town Hall.